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REPORT SAMSO-TR-78-72

Minutes of the Meeting for Microcircuit Manufacturers on the New Class S Space Parts Documentation

Prepared by M. M. Metfessel
The Aerospace Corporation
El Segundo, Calif. 90245

15 January 1978

Final Report

Prepared for
SPACE AND MISSILE SYSTEMS ORGANIZATION
AIR FORCE SYSTEMS COMMAND
Los Angeles Air Force Station
P.O. Box 92960, Worldway Postal Center
Los Angeles, Calif. 90009

This final report was submitted by The Aerospace Corporation, El Segundo, CA 90245, under Contract F04701-77-C-0078 with the Space and Missile Systems Organization, P.O. Box 92960, Worldway Postal Center, Los Angeles, CA 90009. It was reviewed and approved for The Aerospace Corporation by W.J. Aston and J.J. Egan, Engineering Science Operations. Lt. Col. Kenneth Blakney, SAMSO/AWSR, was the project officer.

This report has been reviewed by the Office of Information (OI) and is releasable to the National Technical Information Service (NTIS). At NTIS it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication. Publication of this report does not constitute Air Force approval of the report's findings or conclusions. It is published only for the exchange and stimulation of ideas.

Approved

Kenneth Blakney, Lt. Col., USAF
Chief, Reliability Branch
Directorate of Acquisition Support

FOR THE COMMANDER

William L. Schlosser, Col., USAF
Director of Acquisition Support

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This report presents the minutes of a technical information interchange meeting, which was open to all microcircuit manufacturers interested in the new Class S documents developed by the Air Force Space and Missile Systems Organization (SAMSO) and the National Aeronautics and Space Administration (NASA). This meeting was held 15 December 1977 at The Aerospace Corporation, El Segundo, California.

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19. KEY WORDS (Continued)

20. ABSTRACT (Continued)

Representatives of SAMSO, NASA, the Defense Electronics Supply Center (DESC) and The Aerospace Corporation made presentations and answered questions on the scope and intent of the new Class S specification and procedural publications.

The initial Class S space parts standards, specifications, and guidelines were provided to the industry participants prior to the meeting and were the following:

- MIL-M-38510D, 31 August 1977, "Microcircuits, General Specifications for,"
- MIL-STD-976, 31 August 1977, "Certification Requirements for JAN Microcircuits," and
- DESC-EQE-44, First Draft, 18 November 1977, "Guidelines for the Implementation of Class S Microcircuit Certification."

CONTENTS

1. INTRODUCTION

This report presents the minutes of a technical information interchange meeting, which was open to all microcircuit manufacturers interested in the new Class S documents developed by the Air Force Space and Missile Systems Organization (SAMSO) and the National Aeronautics and Space Administration (NASA). This meeting was held 15 December 1977 at The Aerospace Corporation, El Segundo, California.

Representatives of SAMSO, NASA, the Defense Electronics Supply Center (DESC) and The Aerospace Corporation made presentations and answered questions on the scope and intent of the new Class S specification and procedural publications.

This meeting was a forum for open discussion of issues of concern on Class S by both industry and Government. Final decisions on controversial matters are usually not made at such meetings. Rather, individual positions and consensus opinions are gathered and studied. These continuing Class S activities are coordinated by W.J. Aston, The Aerospace Corporation, and Lt. Col. Ken Blakney, SAMSO/AWSR.

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- MIL-STD-976, 31 August 1977, "Certification Requirement for JAN Microcircuits."
- DESC-EQE-44, First Draft, 18 November 1977, "Guidelines for the Implementation of Class S Microcircuit Certification."

DESC-EQE-44 is provided in Appendix A.

Single copies of the military specification (MIL-M-38510D) and standard (MIL-STD-976) may be requested by mail or telephone from the Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia PA 19120. Not more than five items may be ordered on a single request; the invitation for bid or contract number should be cited where applicable. Only latest revisions (complete with latest amendments) are available; slash sheets must be individually requested. Request all items by document number. For information on subscription service, direct inquiries to the above address with additional marking ATTN: Code 56, or telephone (215) 697-2179, Inquiry Desk.

Information on ordering copies of Federal specifications and standards may be obtained from General Services Administration offices in Atlanta; Auburn; Washington; Boston; Chicago; Denver; Fort Worth; Kansas City, MO; Los Angeles; New Orleans; New York; San Francisco; and Washington, D. C.

At this meeting an introduction and background of the Class S space parts program were given; MIL-M-38510D Class S requirements and test methods 5004 and 5005 of MIL-STD-883 were presented; manufacturer certification for Class S and the Class S qualification process were discussed; part types of current and future interest were furnished; and responses to submitted questions and an open discussion were held. The complete meeting agenda is given in Section 2.

Bill Aston, The Aerospace Corporation, organized and chaired the meeting.

A list of attendees is given in Appendix B.

2. MEETING AGENDA

The agenda consisted of the following items:

1.	Welcome	W. Aston, Dr. W.F. Leverton, The Aerospace Corporation
2.	Introduction	Col. L.A. Anderson, DESC
3.	Background	W. Aston, The Aerospace Corp.
4.	MIL-M-38510D Class S Requirements; Test Methods 5004 and 5005, MIL-STD-883	J. Egan, The Aerospace Corp.
5.	Manufacturer Certification for Class S MIL-STD-976 Certification Guidelines (EQE-44) Delta Certification Criteria	L. Hamiter, NASA/MSFC
6.	Class S Qualification Process	R. Grillmeier, DESC
7.	Part Types of Current and Future Interest	L. Hamiter, NASA A. Borofsky, The Aerospace Corp.
8.	Responses to Submitted Questions General MIL-M-38510D MIL-STD-976 DESC-EQE-44	W. Aston, The Aerospace Corp.
9.	Open Discussion	Panel: W. Aston, The Aerospace Corp. Lt. Col. K. Blakney, SAMSO/AWSR J. Egan, The Aerospace Corp. R. Grillmeier, DESC L. Hamiter, NASA/MSFC L. Murphy, Hq/NASA A. Borofsky, The Aerospace Corp.
10.	Closing Remarks	Col. W.L. Schlosser, SAMSO/AW

3. DISCUSSION

The agenda items provided in Section 2 were presented and discussed. Summaries of the presentations and significant discussion, resolutions, and action items are given in the following paragraphs.

Agenda Item 1.

Welcome. . . . . Bill Aston, Dr. W.F. Leverton, The Aerospace Corporation

The meeting was opened by Bill Aston, The Aerospace Corporation, with a greeting to the attendees. He introduced Dr. W.F. Leverton, Vice President and General Manager, Satellite Systems Division, The Aerospace Corporation.

Dr. Leverton pointed out the following on the new Class S program:

"This whole venture is very dependent upon a cooperative effort. There is no point starting with unrealistic specifications or unrealistic promises on either side. There is no use in giving the customer a money back guarantee because from 20,000 miles away that guarantee doesn't help a whole lot. I'm not going to go through some of the horror stories we have been through with piece parts. Those of you who have produced some bad piece parts can bare your backs and show the scars. Those of us who have tried to use some bad piece parts can also show some scars.

"The purpose of this meeting today as you know is to discuss and hopefully to clarify the new documents related to the Class S parts. These documents do represent a cooperative effort. I think it is very important to emphasize that both DoD and NASA are in this together and I think this is an important step in getting a consolidated market which will maximize the customer's chance of a good product and the vendor's chance of being able to produce it at a profit.

"On the subject of what kind of a market it is, I am pleased that we don't so often hear anymore that it is such a tiny market that this company or that company doesn't care. I think many of us have made that argument. I made it a long time ago when I was on the device side of the business. The truth is, it is a market where the manufacturer can make a profit, he can get his new technology into use and proven. It does require that he posture himself properly for that, and it does require that he and the customer understand one another well enough and early enough so that he isn't promising something and the customer isn't asking for something, neither of which is quite realizable; because that only leads to frustration later on."

Dr. Leverton concluded by welcoming the meeting participants to The Aerospace Corporation and to Southern California.

Agenda Item 2.

Introduction. . . . . .Col. Loren A. Anderson, DESC

Colonel Loren A. Anderson, DESC, established perspective on the Class S qualification program with the following information:

"This meeting represents a milestone in the evolvement of Class S devices under MIL-M-38510D, and more significantly, the joining of DESC, NASA, and SAMSO to effectively administer and invoke the Class S qualification and certification requirements. We in government firmly believe working together on this issue is the way to go and wide support exists at the command level for the program. In the past DESC, NASA, and SAMSO have been essentially operating on their own to qualify high reliability parts. DESC has administered qualification for Class B and C devices, and has authorized testing and evaluated test reports for the old Class A devices. NASA has conducted their own line certification audits for the old Class A devices. SAMSO has been administering their own quality program under MIL-M-0038510B. The net result has been duplication and overlap of audits at the manufacturers' plants by the three activities. In addition to audit overlap, audit uniformity and consistency have been a concern.

"Now that the new Class S has been placed under MIL-M-38510D, and MIL-M-0038510B has been superseded, and MIL-STD-976 has been issued, a new look has been taken at the qualification and certification requirements of microcircuits.

"I would like to explain how DESC, SAMSO, and NASA will work together in the Class S qualification program. The Defense Electronics Supply Center, DESC-EQ, as the DoD focal point for the JAN microcircuit program, will perform all administrative work on Class S devices. This includes paperwork involved in the qualification of microcircuits and the certification of manufacturers' facilities. DESC, NASA, and SAMSO will agree on a chairman for an audit. For potential Class S line audits,

chairmanship will normally be either NASA or SAMSO. Following an audit, DESC will issue audit deficiency letters, coordinate corrective actions, issue certification letters, authorize testing, evaluate test reports, and issue notification of qualification.

"The key point in Class S qualification is the provision for a joint team audit composed of individual members from each government activity that has an interest. This will result in several advantages:

a. Minimize company's time spent during audits
b. Eliminate audit duplication and overlap
c. Reduce overall government audit expense
d. Improve uniformity of audits

"To effect this last advantage, we plan to restrict the number of participants performing the audit to provide an efficient team. Only the people essential for the audit will be in attendance. This will ensure cost effectiveness and provide a uniform audit in minimum time.

"A significant ingredient for a successful qualification program is fair and equitable treatment of all manufacturers. We need to be on guard that the requirements which we set forth are in fact needed and realistic and that they will satisfy our needs. Fair and equitable treatment will be improved through the joint efforts of DESC, NASA, and SAMSO. Another significant ingredient for a successful qualification program is a market for devices. The market place for Class S devices should now be enhanced through the combined usage of both NASA and SAMSO.

"Aside from the qualification program, other goals need to be accomplished. With the incorporation of Class S devices in MIL-M-38510D, we should strive to establish Class S devices as preferred for logistics purposes. This would minimize the number of varieties of devices that need to be stocked for support purposes. While the cost of Class S devices initially would be somewhat higher, with an increase in usage, it might be feasible to stock only the Class S level device for replacement purposes because of the high cost of maintenance. In most cases the net result would be lower life cycle costs.

"We are optimistic about this meeting today and believe it will be a major milestone in the accomplishment of our expectations in the microcircuit qualification program."

Agenda Item 3.

Background. . . . . W. Aston, The Aerospace Corporation

Mr. Bill Aston, The Aerospace Corporation, furnished insight on the problems, circumstances, and events which lead to the development of the Class S program:

"I would like to spend a few minutes perhaps expanding a little bit on what Dr. Leverton was saying about the problems we have seen from the user end. When I say 'we' I am talking particularly SAMSO and Aerospace but the NASA experience has been so similar as to be essentially identical. So therefore, what I'm saying even though it says 'SAMSO,' I think you can safely interpret it to mean 'SAMSO and NASA' in terms of their satellite and launch vehicle programs.

"I am sure that much of what I'll be saying here is certainly not new to many of you, but in order to put the purposes of this meeting in perspective, I think it is worthwhile to quickly run through the problems as we see them from the system end of the business. As most of you know, we are going to longer duration missions; we are now talking of mean mission durations of anywhere from 7 to 10 years for some of our programs.

"We have experienced significant traumatic difficulties with flight and ground failures of SAMSO systems. We have had ground failures that have required massive change-outs, that cost in the millions of dollars, and with significant schedule slips.

"We have had difficulty in buying the level of quality we need. We find our subcontractors in many cases do not have the capability of our prime contractors in having the sophistication to know what to buy and how to buy it and so forth.

"We do ourselves some damage in incremental procurements by programs. This has been addressed from time to time in many forums. All we can really say about it is that we don't expect it to change significantly because that is the way the Congress authorizes the money. There is just not much we can do about it.

"The specification area is of course really what we will be talking about today. We (SAMSO) have tended to rely extensively on contractor specifications. We have spent a lot of money developing, redeveloping, and reinventing those specifications on every program.

"Some programs have tried to rely on screening as the means of ensuring quality. We don't feel that screening is really the best way to go. Certainly there are advantages and certainly all our specifications have screening. We just cannot accept the concept that you can buy junk and screen it up to high quality. So to summarize what we think are the deficiencies of our approach in the past: (1) again we have relied on contractor specifications, (2) and have not pushed for standardization, (3) we've seen significant evidence of an arm's length relationship between part manufacturers and the contractors and (4) I've mentioned the subcontractor problem. Depending upon the people and their level of experience, there are significant variations, program by program, in people's understanding of what high quality parts are and how to get them.

"Sort of the bottom line on the problem, we have had flight failures. One might say it is fairly difficult to determine what actually caused the failure. In some cases we have actually been able to attribute the failure to a specific piece part that cost us the loss of a launch vehicle, satellites, and an operational capability for the country.

"I have mentioned before that we have had extensive rework and retest. It has cost us millions in the past, it is still costing us millions today in on-going programs.

"We at Aerospace and SAMSO are the ones in the final analysis who have to make the decision whether to fly or not. When we know we have low quality or suspect parts, it is a tough decision.

"Back in the 1972-1973 time period, we did try to tighten up the approach our contractors used in managing their parts programs; that was the document called SAMSO-STD-73-2. We did develop a Class S specification, MIL-M-0038510. It turned out that TI was the only supplier. We have talked to each other through the Space Parts Working Group. All of those efforts didn't seem to be solving the problem because in the 1975-1976 time period we again experienced some very significant failures. We were still having procurement difficulties. Then the SAMSO Commander, General Thomas W. Morgan, decided that it was really time to try to take a new approach to this whole thing. He established what is known as the SAMSO/Aerospace Select Committee on Piece Parts. The SAMSO members of the committee are Col. Bill Schlosser, Col. Norm Johnson and Lt. Col. Ken Blakney; the Aerospace members are Dr. Walt Leverton, Dr. Max Weiss, and myself.

"After we formed this committee we went around and visited with a number of our contractors. We discussed all of the aspects of the problem. From these discussions we came up with several alternative strategies. These were discussed in some detail with General Morgan and his staff. General Morgan accepted our recommendation and we then had what we call the preferred strategy.

"Following that, we evolved to the point of deciding that this was no longer the time or the arena for SAMSO to go it alone, and that really we should start talking to NASA and DESC. Toward that end, this past summer and fall we have had a number of meetings to try to solidify our position.

"I have mentioned that NASA has had similar problems. They have had in existence for several years a parts steering committee headed by Mr. Larry Murphy, NASA Headquarters. They have had a program of line

certification for Class A that has been handled principally out of Marshall Space Flight Center with the DESC people. They have established the standard parts program. They have participated in the Space Parts Working Group. But in the past six months or so, through these series of meetings, we feel we have established a new, much stronger, much more solidified relationship with NASA, DESC, and RADC.

"I have said we selected a preferred strategy. In a nutshell, this is the preferred strategy: the use of Class S parts, Class S requirements. We also have a SAMSO policy that says that programs will use the method of coordinated procurement. What that means is that to the greatest extent possible, the prime contractor will arrange for and consolidate the procurement of parts for the entire program, including his subcontractors. This is not a totally new concept. It has been used and used successfully on a number of programs, which is the reason we thought it might be good to do across the board.

"The third key element from our viewpoint is manufacturer monitoring. This again is something that has been used and used successfully by a number of programs over the years. We feel it is an essential element in ensuring ourselves that we're getting what we think we're getting and what we want to get.

"Microcircuits are what we are talking about at this meeting today. We've been involved in an effort with NASA, DESC, and the Navy. In the next couple of months or so there will be a new version of MIL-S-19500 ('General Specification for Semiconductor Devices') for discretes that will incorporate the concept of Class S. We have developed the certification requirements, the MIL-STD-976. We are ready to start into the certification process. The ultimate objective, and I'm not sure how long it's going to take us to get there and I can't really give you a timetable, is a SAMSO/NASA preferred parts list for space.

"Where do we go from here? We think we have taken the first step. We have developed what we think are the requirements that we need; now we have to implement these requirements, put them into practice. We start, of course, with the certification and qualification. We intend, and I believe that this is NASA policy also, to require the use of Class S, certainly for all new programs and wherever we can for new buys for existing programs, block charges and so forth. We intend to require contractor monitoring of Class S. Hopefully, of course, we will move over the next months into newer technologies, including hybrids which are a big problem area. And we will move also into the other new technologies that are coming along: microprocessors, memory devices, LSI and so forth.

"I think this concludes the background aspect of Class S."

(Reproductions of the vu-graphs presented by Mr. Aston are given in the five pages which follow.)

CLASS S MICROCIRCUIT INTERCHANGE MEETING

DECEMBER 15, 1977

W. J. ASTON
THE AEROSPACE CORPORATION

THE PROBLEM

- LONGER, MORE COMPLEX MISSIONS REQUIRE HIGHER RELIABILITY
- SINGLE PART FAILURE CAN CAUSE SPACE SYSTEM / MISSION FAILURE
- SIGNIFICANT FLIGHT AND GROUND FAILURES OF SAMSO SYSTEMS
- SAMSO PROGRAMS HAVE HAD GREAT DIFFICULTY IN PROCURING HIGHEST RELIABILITY "SPACE" ELECTRONIC PARTS

ELEMENTS OF THE PROBLEM

- HIGHEST QUALITY LEVEL PARTS DIFFICULT TO BUY
  - COMMERCIAL PRODUCTION HAS PRIORITY
  - FRAGMENTED PURCHASING FOR SAMSO PROGRAMS LEADS TO LACK OF INTEREST BY VENDOR
  - LONG LEAD TIMES VS TIGHT SCHEDULES
  - QUALIFIED SOURCES ARE LIMITED
  - SUBCONTRACTORS FREQUENTLY HAVE INADEQUATE PARTS GROUP
  - INCREMENTAL PROCUREMENT BY PROGRAM
  - LACK OF STABLE SPACE PARTS PRODUCTION BASE AT VENDOR
- MILITARY / CONTRACTOR SPECIFICATIONS ARE NOT CONSISTENT OR COMPREHENSIVE
  - VARIABLE REQUIREMENTS ADD TO COST AND CONFUSION
  - CONTRACTOR REQUIREMENT TO GENERATE SPECS IMPACTS COST AND SCHEDULE
- SCREENING TO UPGRADE LOWER QUALITY PARTS INVOLVES RISK AND AND MAY INCREASE COST
  - SCREENING NOT RELIABLE FOR ALL FAILURE MECHANISMS
  - CONTRACTOR TESTING, FAILURE ANALYSES, AND FAILURES AT HIGHER ASSEMBLY CAN IMPACT COST AND SCHEDULE
- DEFICIENCIES IN PAST SAMSO / AEROSPACE APPROACH
  - PRINCIPAL RELIANCE ON CONTRACTOR SPECIFICATIONS AND SCREENING
  - FRAGMENTATION OF PURCHASING
  - INADEQUATE STANDARDIZATION
  - LACK OF CLOSE VENDOR - CONTRACTOR RELATIONSHIP
  - LACK OF CONTROL OF SUBCONTRACTORS
  - EMPHASIS ON PARTS QUALITY VARIABLE BY PROGRAM

ELEMENTS OF THE PROBLEM (CONTINUED)

- RELIABILITY PROBLEMS RESULTING IN:
  - FLIGHT FAILURES AND ANOMALIES ATTRIBUTABLE TO PIECE PARTS
  - EXTENSIVE REWORK AND RETEST RESULTING FROM BAD PIECE PARTS BUILT INTO VEHICLE EQUIPMENT
  - COMMAND LEVEL ANGUISH OVER GO / NO GO FLIGHT DECISIONS WITH KNOWN OR SUSPECT BAD PIECE PARTS

SAMSO EVENTS LEADING TO NEW PARTS PROGRAM

1972 - 1976

- FAILURES, ANOMALIES, PROCUREMENT DIFFICULTIES
- PART REQUIREMENTS STANDARD DEVELOPED (SAMSO-STD-73-2)
- CLASS "S" (0038510) TTL MICROCIRCUIT LINE DEVELOPED
- SAMSO / NASA / INDUSTRY SPACE PARTS WORKING GROUP

1976 - 1977

- NEW FAILURES, ANOMALIES, PROCUREMENT DIFFICULTIES
- COMMANDER ESTABLISHES SAMSO / AEROSPACE SELECT COMMITTEE
- INDUSTRY VISITS / PARTS PROGRAMS REVIEWED
- ALTERNATIVE STRATEGIES EXAMINED
- PREFERRED STRATEGY SELECTED
- MEETING WITH NASA, AGREEMENTS ON JOINT APPROACH
- MEETINGS WITH DESC / RADC

NASA EVENTS LEADING TO NEW PARTS PROGRAM

- SIMILAR PROBLEMS WITH ELECTRONIC PARTS, PROCUREMENT ETC
- NASA PARTS STEERING COMMITTEE
- NASA LINE CERTIFICATIONS
- NASA STANDARD PARTS PROGRAM ESTABLISHED
- NASA PARTICIPATION IN SAMSO / NASA / INDUSTRY SPACE PARTS WORKING GROUP
- SAMSO / NASA MEETING / AGREEMENTS

NEW SAMSO PARTS POLICIES

- USE OF CLASS S PARTS / REQUIREMENTS
- COORDINATED PROCUREMENT
- MANUFACTURER MONITORING

JOINT SAMSO / NASA PARTS APPROACH

- DEVELOP JOINT CLASS "S" (SPACE QUALITY) REQUIREMENTS
  - MICROCIRCUITS
  - DIODES / TRANSISTORS
  - HYBRIDS
  - OTHER DEVICES
- INCORPORATE CLASS "S" INTO MIL SPECS
- DEVELOP CLASS "S" CERTIFICATION REQUIREMENTS
- SAMSO / NASA / DESC CERTIFICATIONS
- DESC / NASA / SAMSO CLASS "S" QUALIFICATIONS
- SAMSO / NASA / DESC BASELINE CONTROL
- SAMSO / NASA PREFERRED PARTS LIST
  - STANDARDIZATION
  - PROCUREMENT VOLUME

WHERE DO WE GO FROM HERE?

- IMPLEMENT STANDARD SPACE QUALITY (CLASS S) SPECIFICATIONS
- INITIATE CERTIFICATION AND QUALIFICATION OF MANUFACTURERS
- IMPLEMENT COORDINATED PROCUREMENT OF CLASS S
  - NEW PROGRAMS
  - NEW BUYS FOR EXISTING PROGRAMS
- REQUIRE CONTRACTOR MONITORING OF CLASS S LINES
- EXPAND CLASS S TO NEWER TECHNOLOGIES
  - HYBRIDS
  - MICROPROCESSORS/MEMORY DEVICES

Agenda Item 4.

MIL-M-38510D Class S Requirements; Test Methods 5004 and 5005, MIL-STD-883. . . . . .J. Egan, The Aerospace Corporation

Mr. Jim Egan, The Aerospace Corporation, included the following information in his remarks on MIL-M-38510D requirements.

"My objective here this morning is to review quickly the requirements of MIL-M-38510D.

"Where did the MIL-M-38510D Class S part requirements come from? First of all, you have to understand our intent. We are intending to specify a part for space applications. We are not interested in a part for low-reliability applications or for moderately reliable military applications; we are talking about parts for space applications where the cost tradeoffs heavily favor the use of the best part that we can buy. You should all remember that this is what we are driving at.

"The Class S requirements in the specifications are designed to prevent known problems. In general, each requirement matches up to a problem we have had one or more times in the past. These are not things that were invented without any real basis.

"The effectiveness of the Class S requirements is predicated on the implementation of all of them. There aren't any magic requirements in these which can be implemented to the exclusion of the others. We are depending upon the implementation of the entire specification and all of its requirements to achieve this high quality.

"Finally, the Class S requirements were derived from specifications which we have successfully used in the past on prior space programs; they reflect screening and test methods which have proven effective for us in the past. The design and construction rules which are in the specification are in there to preclude known reliability problems. The established control

techniques that we have in there are things we have used in the past. All these requirements have received extensive coordination with both our contractors and manufacturers. There is nothing new in there.

"I have tried to summarize the Class S requirements by breaking them down into nine major categories, and they are shown in the vu-graphs.

1. manufacturing baseline
2. design and construction requirements
3. product assurance program
4. certification of manufacturers
5. Class S qualification requirements
6. wafer lot acceptance
7. Class S screening requirements
8. quality conformance testing
9. Government Source Inspection (GSI)

"With regard to Par. 4.1.4 of MIL-M-38510D, the expression 'government designated representatives' should be read as 'contractors.' The terms 'surveillance' and 'monitoring' do not mean 100% witnessing necessarily nor do they mean that the inspector will perform these particular tests. Rather, they mean the inspector will maintain cognizance of these tests that are being performed on each lot, and he will check the results of these tests as performed on each lot or relative to each lot; and he may witness some of the testing that is performed on each lot, depending upon what he feels is required to adequately monitor these items.

"The words 'up to 100%' are key. The inspector accomplishes his function as he deems it necessary by watching the inspections being accomplished, by repeating a portion of the inspections or by repeating the inspections in their entirety. This is a function of what the inspector thinks necessary to do the job, and will be predicated upon his experience and the existence of past problems."

(Reproductions of the vu-graphs presented by Mr. Egan are given in the six pages which follow.)

MIL-M-38510D CLASS S REQUIREMENTS

DECEMBER 15, 1977

BASIS FOR MIL-M-38510 CLASS S REQUIREMENTS

- CLASS S PARTS ARE INTENDED FOR SPACE APPLICATIONS WHERE COST TRADE-OFFS HEAVILY FAVOR USE OF THE HIGHEST QUALITY POSSIBLE.
- THE CLASS S REQUIREMENTS ARE DESIGNED TO PREVENT KNOWN PROBLEMS.
- THE EFFECTIVENESS OF THE CLASS S REQUIREMENTS IS PREDICATED ON THEIR COMPOSITE IMPLEMENTATION.
- THE CLASS S REQUIREMENTS WERE DERIVED FROM:
    - SPECIFICATIONS WHICH HAVE BEEN SUCCESSFULLY USED ON PRIOR SPACE PROGRAMS.
    - SCREENING AND TEST METHODS WHICH HAVE PROVEN TO BE EFFECTIVE.
    - DESIGN AND CONSTRUCTION RULES WHICH PRECLUDE WELL KNOWN RELIABILITY PROBLEMS.
    - ESTABLISHED PROCESS CONTROL TECHNIQUES.
    - EXTENSIVE COORDINATION WITH CONTRACTORS AND MANUFACTURERS.

MIL-M-38510D CLASS S* REQUIREMENTS

- MANUFACTURING BASELINE/PRODUCT CHANGE CONTROL
- DESIGN AND CONSTRUCTION REQUIREMENTS
- PRODUCT ASSURANCE PROGRAM
- CERTIFICATION OF MANUFACTURERS
- QUALIFICATION TEST PER MIL-STD-883, METHOD 5005.4 (TWO LOTS)
- WAFER LOT ACCEPTANCE PER MIL-STD-883 METHOD 5007
- SCREENING PER MIL-STD-883 METHOD 5004.4
- QUALITY CONFORMANCE TESTING PER MIL-STD-883, METHOD 5005.4
- GOVERNMENT SOURCE INSPECTION.

*Class S Replaces and Supercedes Class A in MIL-M-38510 and MIL-STD-883 and Class S in MIL-M-0038510.

MANUFACTURING BASELINE

- MANUFACTURING FLOW CHART (APPENDIX A, PARA. 20.1.3.2)
  - ALL MANUFACTURING, INSPECTION, TESTING AND QUALITY VERIFICATION POINTS.
  - ALL POINTS WHERE MATERIALS OR ASSEMBLIES ENTER FLOW.
  - KEYED TO CONTROLLING DOCUMENTS; TITLE, NUMBER AND REVISION

- CHANGE CONTROL (MIL-M-38510D PARA. 3.4.2)
  - ALL "MAJOR CHANGES" IN DESIGN OR MANUFACTURING PROCESS MUST BE APPROVED BY QUALIFYING ACTIVITY.
  - EXAMPLES OF "MAJOR CHANGES" LISTED IN PARA. 3.4.2

DESIGN AND CONSTRUCTION REQUIREMENTS

- PACKAGE, (HERMETIC, NO ORGANIC OR POLYMERIC COATINGS, OR DESICCANTS, MOISTURE CONTENT)
- METALS, (CORROSION RESISTANT)
- DESIGN DOCUMENTATION (TOPOGRAPHY, SCHEMATIC)
- INTERNAL CONDUCTORS, (MATERIAL, CURRENT DENSITY, DIMENSIONS)
- LEAD MATERIAL AND FINISH
- DIE PLATING AND MOUNTING (NO GLASS DIE MOUNTING)
- GLASSIVATION (REQUIRED, 6000A MIN.)
- DIE THICKNESS, (.006 INCH MIN.)

PRODUCT ASSURANCE PROGRAM

- DETAILS OF PRODUCT ASSURANCE PROGRAM REQUIREMENTS GIVEN IN MIL-M-38510D APPENDIX A.

- THE PROGRAM IS DOCUMENTED AS FOLLOWS:
  - DESIGN, PROCESSING, MANUFACTURING INSTRUCTIONS
  - IN-HOUSE RECORDS
  - PRODUCT ASSURANCE PROGRAM PLAN
  - DETAILED SUMMARY PRESENTED IN TABLE I OF APPENDIX A.

CERTIFICATION OF MANUFACTURERS

- IN ACCORDANCE WITH THE REQUIREMENTS OF MIL-STD-976

- REQUIRES THE ESTABLISHMENT AND IMPLEMENTATION OF A PRODUCT ASSURANCE PROGRAM

- PRE-SURVEY INFORMATION REQUIRED:
  - PRODUCT ASSURANCE PROGRAM PLAN
  - MANUFACTURING BASELINE

- MANUFACTURER SURVEY BY QUALIFYING ACTIVITY TEAM

- PERIODIC (SCHEDULED) POST CERTIFICATION AUDITS

- A CERTIFIED LINE SHALL CONTINUE TO MEET CERTIFICATION REQUIREMENTS WHEN OTHER THAN CLASS S PRODUCT IS BEING MANUFACTURED.

CLASS S QUALIFICATION REQUIREMENTS

- PER MIL-STD-883B, METHOD 5004.4
- REQUIRES CLASS S LINE CERTIFICATION AS A PRECONDITION
- QUALIFICATION TESTS PERFORMED ON TWO CLASS S INSPECTION LOTS, (UNIQUE LOT I AND LOT II SAMPLING)
- INCLUDES THE FULL REQUIREMENTS OF GROUP A, B, AND D TESTS.

WAFER LOT ACCEPTANCE

- CONDUCTED IN ACCORDANCE WITH MIL-STD-883, METHOD 5007.1
- SAMPLE INSPECTION INITIALLY; EACH WAFER ON RESUBMISSION
- ACCEPTANCE TESTS:
  - WAFER THICKNESS
  - METAL THICKNESS
  - THERMAL STABILITY
  - SEM
  - GLASSIVATION THICKNESS
  - GOLD BACKING THICKNESS
- GOVERNMENT/CONTRACTOR SOURCE SURVEILLANCE.

CLASS S SCREENING REQUIREMENTS

- CONDUCTED IN ACCORDANCE WITH MIL-STD-883B, METHOD 5004.4
- INCLUDES PARTICLE IMPACT NOISE DETECTION (PIND) TESTING AND TWO VIEWS AT X-RAY
- BURN-IN WILL INCLUDE PDA (10%) AND DELTA LIMITS
- MAXIMUM INSPECTION LOT SIZE OF 600.
- LOTS MAY BE RESUBMITTED ONCE TO A TIGHTENED (3%) PDA.
- NO PRE-BURN-IN IS ALLOWED.
- ANALYSIS OF CATASTROPHIC BURN-IN FAILURES TO THE EXTENT NECESSARY TO IDENTIFY FAILURE MECHANISMS.

QUALITY CONFORMANCE TESTING

- PERFORMED ON EACH CLASS S INSPECTION LOT.
- CONDUCTED IN ACCORDANCE WITH MIL-STD-883B, METHOD 5005.4.
- NORMALLY INCLUDES GROUP A AND GROUP B TESTS ONLY.
- UTILIZES "LOT 2 AND SUBSEQUENT" SAMPLING PLAN.
- REQUIRES MEASUREMENT OF INTERNAL WATER VAPOR CONTENT.

GOVERNMENT SOURCE INSPECTION (PARA. 4.1.4)

- PERFORMED BY GOVERNMENT PERSONNEL AND (WHEN REQUIRED BY CONTRACT) GOVERNMENT DESIGNATED REPRESENTATIVES.
- WILL BE PERFORMED ON EACH CLASS S INSPECTION LOT.
- APPLIES TO THE MANUFACTURING PROCESS FROM WAFER LOT ACCEPTANCE TO SHIPMENT OF COMPLETED PRODUCT.
- REQUIRES THE GOVERNMENT INSPECTOR(S) TO:
  - PERFORM SURVEILLANCE AND MONITORING OF, AS A MINIMUM:
    - WAFER LOT ACCEPTANCE
    - IN-PROCESS DIE SHEAR AND BOND STRENGTH TESTS
    - BURN-IN BOARD CHECKOUT
    - GROUP B, SUBGROUP 2 TESTING
  - WITNESS OR PERFORM (UP TO 100%) VISUAL EXAMINATION AT DIE INSPECTION AND AT PRESEAL.
  - PERFORM A FINAL AUDIT OF DOCUMENTATION FOR EACH LOT.

Agenda Item 5.

Manufacturer Certification for Class S, MIL-STD-976, Certification Guidelines (EQE-44), Delta Certification Criteria. . . . . L. Hamiter, NASA/MSFC

Mr. Leon Hamiter summarized MIL-STD-976, "Certification Requirement for JAN Microcircuits;" DESC-EQE-44, "Guidelines for the Implementation of Class S Microcircuit Certification;" and discussed what NASA considered to be a change from a Class A certification to a Class S certification:

"What I am going to do is merely highlight the requirements which are in the line certification document. Most of you are quite familiar with them and I don't think this is the time or place to concentrate on a lot of details. I am also going to explain to you a little bit about the guidelines we have published and provide a copy to you on how the team will conduct line certification. And then I have tabulated a list of the things we consider a delta from a Class A certification to a Class S certification, since some of you presently are Class A certified. We want you to see what is really involved in transferring over to a Class S.

"Now let me try to emphasize a couple of points about line certification before we look at the requirements. Point 1. Line certification in no way is intended to try to prescribe methods and techniques for you to build your product. You are supposed to have the technical experts required to design, fabricate, and control your product.

"We all know that under very strenuous pressure to reduce the price, some part manufacturers try to shorten the cycle from the start of a wafer until they ship the product out the back door; they do all these kinds of things. Quite frequently part manufacturers are forced into shortcuts and doing things they really realize is not the best way of building a high quality device.

"Now line certification is really a technique by which we try to assess your processes, your capabilities, and your controls so they will result in what we consider to be a high quality, Class S product.

"Many people seem to think we are really prescribing the way. I will cover this further in some detail. Even though we have guidelines, we are still not prescribing your intimate approaches and techniques. You are intended to have that flexibility.

"Let's look at the first requirement. Now as I have said, MIL-STD-976; most of you remember the old NASA NHB. You received a copy of MIL-STD-976 in your letter that came out concerning the meeting. It was published in August. We've had meetings around tables with many of you or your technical representatives. We've screamed, yelled, and pounded the table. But basically we've got a document that I think we can really live with. It undoubtedly will have some rough edges that we'll find as we get into the program. It certainly is our intention, wherever possible, to take the sandpaper and remove the rough edges.

"The scope of it though is to establish requirements for certification and for maintenance of manufacturing and testing facilities for the production of JAN microcircuits.

"This document is divided into general requirements and detail requirements. In the general requirements area, we talk about preaudit. Concerning the need for a preaudit, we advise you on the kind of things you should do to request and prepare for a preaudit. We also refer to the product assurance program which is a requirement of the general specification and is comprehensively defined in Appendix A of MIL-M-38510D.

"Other kinds of things we have concentrated on during certification are calibration and calibration techniques. These are all basics of the product assurance program. In regard to your test facilities, we want to look at the capability and the procedures you use to be sure that they will in reality implement the requirements. Regarding design and construction baseline, as you know, there are some criteria specified in the specification on design and construction. There are many, many more that you and your people have to have in the design and production of your devices. This is to concentrate on those.

"Then of course there is the actual performance of the audit. MIL-STD-976 also tells you how certification is granted. And it also tells you how if you are bad boys you can lose your certification. So we feel it is important that you understand those ground rules beforehand.

"In the area of the detail requirements, they are broken down into systematic requirements that apply to all classes of product. MIL-STD-976 does contain the certification requirements for all classes. At this meeting, of course, we are concentrating on Class S.

"In the systematic area, it deals with the documentation, incoming inspection, materials control, environmental control, water control, and, of course, testing. We are concentrating on both electrical and environmental testing--that you in reality have a failure analysis capability, to really understand causes of failure, identify the physics involved, and corrective actions necessary to improve the product. There also would be handling and training requirements.

"Next under the detail requirements we get into those things which are peculiar to Class B and Class C. Let me explain what I mean by peculiar to Class B and Class C. Everything that I'm covering here under detail requirements is cumulative and applies to Class S. The things that are labeled to Classes B and C are applicable when you are only Class B and C certified. But they also are applicable for Class S certification.

"And this concentrates on the processes and controls related to oxidation, patterning, epitaxy, all these types of things. Now if you will notice there are some of the subjects of the same heading in the Class B column as in the Class S column. An example is the CV plot in the Class B; it merely prescribes that you have methods and techniques for doing your normal CV plots. The CV plot under Class S says that you will have methods and techniques for performing it in accordance with a test method that is in a NASA document. So where we have the same subject in a Class S as in a Class B it is because it is in addition to or because it has some additional criteria involved with it. And it is not in itself a duplication of what was covered in Class B.

"Now as I have mentioned, many of you people have been through these requirements; you are certainly familiar with the documents. We will entertain questions later because we notice by some of the questions you've submitted, you do have some concerns and some questions in these areas; some of which are very easily answered and are probably only misunderstandings.

"Let's look at the next major document that was sprung on you very recently in the letter announcing this meeting. And that is the "Guidelines for the Implementation of Class S Microcircuit Certification," DESC-EQE-44.

"I would like to show you exactly how this document is organized. And you may notice this is not carrying what we consider a normal military documentation system number; because this is really an in-house work document to be used by the certification team. Therefore, it is carrying a DESC number. And I would like to emphasize as many times as necessary to get across the point, that it means what the word says in the title: "guidelines." Not hard requirements, guidelines. The scope of the document is to provide guidelines to the certification team for implementing the Class S certification of microcircuit manufacturing facilities.

"Now what really is the purpose of the document? As you know, you part manufacturers are scattered all over the country even though there is a predominance on the West Coast. But we have to put together teams. We won't always have the same team, the same members of the team. And it would not be fair to you, and it would not be fair to us, if when we say someone is Class S certified they do not all meet the same requirements. So the purpose of the document is to try to bring uniformity to the team's assessment of your capability to properly control your product so that it is a Class S quality level.

"This document is somewhat divided up into standard mil approaches with the scope, the purpose, I went through. And then there is a set of instructions. I would like to highlight a couple of points that are in the instructions. The first point says this document does not contain everything the certification team is going to look at. They can look at other things. Now we are

not saying that they will look at anything beyond the scope of the tier of all the documents involved.

"What is the scope of all the tiers involved? It is MIL-M-38510; there are some things in there that have to be looked at; MIL-STD-883 has a couple of methods involved, they have to be looked at to see that you really have the capability of implementing and really meeting the intent of the method. Appendix A of MIL-M-38510, is the product assurance program; it will be looked at. Then there also is MIL-STD-976.

"Now we think the key important points related to wafer fabrication, to assembly of the device, and to the test and inspection of the completed product are in this guidelines document. We tried to lift them out and cover them.

"Those are the prime things they are going to concentrate on. But there could be a few things that somewhere else in the document will be looked at.

"The second major thing in the instructions of this document is that these are recommended limits, measurement frequency, and records for the guidance of the team. These should not be considered hard requirements. The team is encouraged to assess the adequacy of the part manufacturer's proposed process controls and techniques to be sure they really meet the intent of what we are after and will give us a good product. We want to do as little meddling as possible in your process, provided it will produce a really good, high quality, Class S device, and also provide consistent requirements from one Class S manufacturer to another Class S qualified manufacturer.

"I'm not going to touch on all the different items we have in this checklist. I'm sure it would bore both you and me. But basically, the page of the checklist is put together so it identifies the item that we're talking about; it tells you the test methods involved, and where we think there is a test method you should be using or considering in your technique of performing a process control. It has in there recommended limits. It also has in there

recommended measurement frequencies. If you can show us that you have a different frequency that is doing the job that needs to be done, then that is what the team is going to assess. The frequencies we have in there are the kind of thing we think is the ideal approach, but for your particular situation it might not be.

"We want the types of records that really ought to be recorded so both you and us can look back at later periods of time to see how the processes were controlled; and then there are also the findings that the team observes on each of their assessments of the process controls.

"Let us move on and see what the delta certification requirements are between an old Class A and a new Class S. Let me state a couple of ground rules relative to the certification. For you people who do presently have a Class A certification, if you would like to have that Class A certification extended to Class S, these are the things the team would normally look at just to transfer it, because this is either a new requirement or some kind of a change or alteration has been made in it since the Class A certification requirement.

"If you choose this approach, your new Class S granted this way would still terminate the same time as the old Class A termination date. In other words, if you had six months left on the old Class A, you would still have only six months left on the new Class S; because it is only assessing portions of the requirements, not the complete requirements. It may very well be that some of you people that have a Class A would prefer to go on and have a full 2-year, Class S certification. Then the team would do the whole Class S certification, rather than the deltas that I have outlined.

"Next, let's consider the die shear operation and the review of the die shear test results. As you are aware, in this MIL-STD-976 we have in there a requirement on wire bond pull testing and die shear test on a time basis for the production line. So this would be looked at. The procedures for PIND testing and review of PIND test results--now this is going to cause us a little

problem at the beginning but the intent of this is that as we go down the road we will be able to come in and look at PIND testing that you have done in accordance with the new test method that is now in MIL-STD-883, which we feel has improved some of the inconsistencies that have previously existed in PIND testing.

"We won't touch on all of these, I think it would take too long. We will identify some of the provisions in the flow charts that would be necessary to see if that the customer source or the Government Source Inspector is notified so that he could perform surveillance or monitoring over certain operations.

"There will be procedures for test equipment verification and data logging.

"We have here another two things that I think are very important: (1) incoming inspection procedures and area for Class S, and (2) procedures for checking continuity of devices in burn-in fixtures.

"Since you buy lots of materials for your whole plant, when they come in they are not necessarily destined for commercial Class B or Class S or what have you; we are not saying that you've got to have something there for incoming control; but we will require if you do not have, that there be certain special controls on incoming materials before it enters the Class S line. So that is a new item that we would look at.

"We have found also in the past that there have been some problems relative to people plugging in their devices in burn-in sockets and having good continuity of the supply voltages and all the input pins and output loading of the devices. There will be a check made here of your program to keep your burn-in sockets up to snuff and in good operating condition.

"Wafer lot acceptance is required on all Class S lots, and we would be looking at all your methods, your techniques for implementing Method 5007.

"We would also want to look at the DPA area. And DPA is a requirement of subgroup B2 of Group B testing for Class S. It is done as a part of quality conformance inspection.

"We have covered the design construction requirements for MIL-M-38510D. In other words, there really is no point in certifying your line as producing a Class S device if there is something in that design or production that doesn't meet one of these design and construction requirements of MIL-M-38510D. So that would be looked at.

"There are a few deltas that were added to the product assurance program for Class S in Revision D that were not in Revision C of MIL-M-38510. These deltas would be looked at.

"That essentially would constitute the delta things that would be checked to extend a Class A certification to a Class S certification."

(Reproductions of the vu-graphs presented by Mr. Hamiter are given in the three pages which follow.)

L. HAMITER
NASA/MSFC

MIL-STD-976 -- CERTIFICATION REQUIREMENTS FOR JAN MICROCIRCUITS
AUG. 31, 1977

SCOPE: ESTABLISH REQUIREMENTS FOR CERTIFICATION AND MAINTENANCE OF CERTIFICATION FOR MANUFACTURING AND TESTING FACILITIES FOR JAN MICROCIRCUITS

GENERAL REQUIREMENTS:
- PRE AUDIT
- PRODUCT ASSURANCE PROGRAM
- CALIBRATION
- TEST FACILITIES, CAPABILITY AND PROCEDURES
- DESIGN AND CONSTRUCTION BASELINE
- MANUFACTURER AUDIT
- CERTIFICATION
- LOSS OF CERTIFICATION

DETAIL REQUIREMENTS:

SYSTEM -
- DOCUMENTATION
- INCOMING INSPECTION
- ENVIRONMENTAL CONTROL
- WATER CONTROL
- TESTING - ELECTRICAL AND ENVIRONMENTAL
- FAILURE ANALYSIS
- HANDLING
- TRAINING

MIL-STD-976 -- CERTIFICATION REQUIREMENTS FOR JAN MICROCIRCUITS, CONTINUED

DETAIL REQUIREMENTS, CONTINUED

CLASSES B AND C
- OXIDATION
- PATTERNING
- EPITAXY
- JUNCTION
- METALLIZATION
- CV PLOT
- GLASSIVATION
- WAFER THINNING
- SCRIBING/DICING
- DIE MOUNTING
- INTERCONNECT MOUNTING
- INTERNAL VISUAL
- SEALING

CLASS S
- SUBSTRATE MEASUREMENTS
- PINHOLE AND CRACK MEASUREMENTS
- STABILITY
- CV PLOT - NHB 5300.4(3G) - 6041B
- WAFER DEFECTS
- PHOTORESIST PINHOLES
- MASKS
- STACKING FAULT - EPI
- METALLIZATION STABILITY
- SEM - PROCEDUERS
- CONTROL OF ASSEMBLY AREA
- BONDING AND STRENGTH
- DIE MOUNT STRENGTH
- INTERNAL VISUAL
- PIND TESTING
- INTERNAL WATER VAPOR
- MAINTENANCE OF CERTIFICATION

L. HAMITER
NASA/MSFC

GUIDELINES FOR IMPLEMENTATION OF CLASS S MICROCIRCUIT CERTIFICATION
DESC - EQE - 44

SCOPE: PROVIDE GUIDELINES TO THE CERTIFICATION TEAM FOR IMPLEMENTING CLASS S CERTIFICATION OF MICROCIRCUIT MANUFACTURING FACILITIES

PURPOSE: ESTABLISH UNIFORM APPROACH FOR TEAM ASSESSMENT FOR CERTIFICATION

INSTRUCTIONS:

CHECKLIST:
- ITEM
- TEST METHOD
- RECOMMENDED LIMITS
- MEASUREMENT FREQUENCY
- RECORDS
- FINDINGS

NOTES:

DELTA CERTIFICATION REQUIREMENTS FOR CLASS A TO CLASS S

DIE SHEAR OPERATION AND REVIEW DIE SHEAR TEST RESULTS.

WIRE BOND PULL OPERATION AND REVIEW PULL STRENGTH TEST RESULTS.

PROCEDURES FOR PIND TEST AND REVIEW PIND TEST RESULTS.

CONTROLS AND DATA ON MOISTURE CONTENT OF PARTS.

GLASSIVATION LAYER INTEGRITY CONTROLS AND DATA.

METAL PACKAGE ISOLATION TEST AND DATA, AS APPLICABLE.

INSPECTION VERIFICATION(S) PROCEDURES.

IDENTIFY PROVISIONS FOR CSI/GSI IN MANUFACTURING FLOW CHART.

PROCEDURES FOR TEST EQUIPMENT VERIFICATION AND DATA LOGGING.

OPERATOR TRAINING PROCEDURES AND RECORDS.

INCOMING INSPECTION PROCEDURES AND AREA FOR CLASS S.

MANUFACTURING BASELINE FOR CLASS S.

PROCEDURES FOR CHECKING CONTINUITY OF DEVICES IN BURN-IN FIXTURES.

WAFER LOT ACCEPTANCE IMPLEMENTATION PER METHOD 5007.

SEM INTERCONNECT BONDING PHOTOS.

DPA (QUALITY CONF. GPB TEST) PROCEDURES.

CLEANLINESS REQUIREMENTS.

DESIGN AND CONSTRUCTION REQUIREMENTS OF 38510

DELTAS TO PRODUCT ASSURANCE PROGRAM.

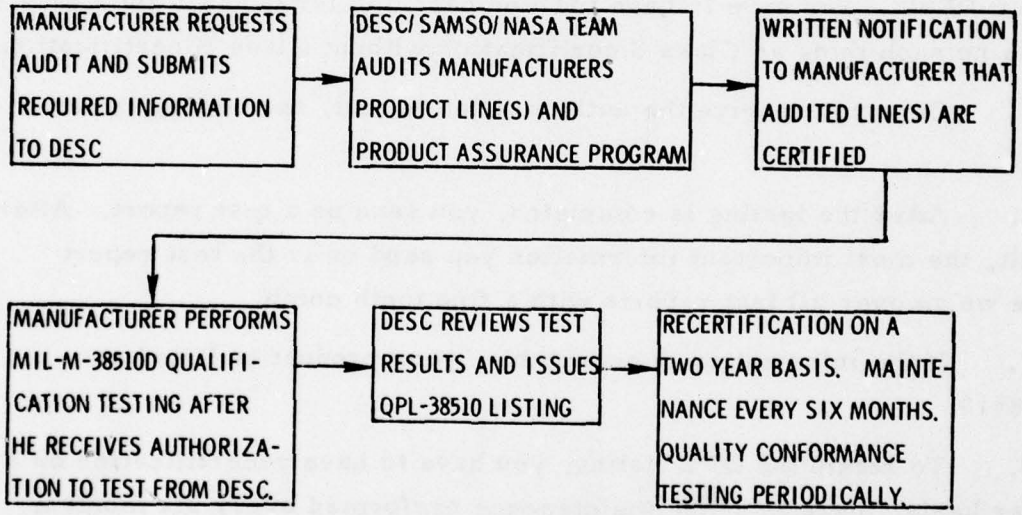
Agenda Item 6.

Class S Qualification Process . . . . . .R. Grillmeier, DESC

Mr. Ray Grillmeier, DESC, discussed the steps to receive Class S manufacturer certification and a Qualified Products Listing:

Figure 1.

STEPS TO RECEIVE CLASS S MANUFACTURER CERTIFICATION AND QUALIFIED PRODUCTS LISTING (QPL)



"This is a summary on how to receive Class S certification and Class S qualification.

1. First of all, you must tell us that you want an audit. Before we will perform the audit, you must send us certain information such as a program plan, calibration information, testing information, and you also must tell us what products you wish to qualify. For example, if you wish to

have us look at a line for a particular product and there is no MIL-M-38510 specification for the product, there is no sense in us auditing the line. However, if a specification for a product is in a rough draft form we will perform the audit.

2. If the preaudit information is acceptable, a joint team of DESC, SAMSO, and NASA will perform the audit.

3. If there are no problems, you will receive a written notification that your line is certified.

4. After your line is certified, you will receive an authorization to test from DESC. You have to have the line certified for Class S and Class B. There is no such thing as Class S certification without Class B certification.

5. Once you receive the authorization to test, the testing is performed.

6. After the testing is completed, you send us a test report. After the audit, the most important information you send us is the test report because we go over all test reports with a fine tooth comb.

7. If the information is acceptable, your product is listed on QPL-38510.

8. To retain the QPL listing, you have to have recertification on a two-year basis, there is a line maintenance performed every six months, and you must perform quality conformance testing on your product periodically."

Figure 2.

CLASS S

1. PRODUCT MUST BE FROM CLASSES S AND B CERTIFIED LINE FOR APPLICABLE TECHNOLOGY.

2. INSPECTION LOT FORMATION (REQUIRED BY 4.3.3, MIL-M-38510D).

3. SCREENING TESTS (100%) METHOD 5004, MIL-STD-883B (4.4.2, MIL-M-38510D) (ALL PRECONDITIONING TESTS USED FOR QUALIFICATION MUST BE PERFORMED ON ALL APPLICABLE JAN MICROCIRCUITS AFTER QUALIFICATION, 3.4.3, MIL-M-38510D).

4. PASS QUALIFICATION TESTS.

NOTE: ALL SCREENING, QUALIFICATION AND QUALITY CONFORMANCE TESTING MUST BE PERFORMED AT A TEST LABORATORY WHICH HAS DESC-EQE SUITABILITY FOR THE 4.1, MIL-M-38510D)

"Now we will discuss the testing part. Again the product must come from a Classes S and B certified line. First, inspection lots are formed, then all the devices go through a screening test. This is a 100% test.

"If you bias the qualification sample to qualify the product, you must do those particular tests from then on. If you perform a special test for qualification, you have to keep performing the test until it can be proven you don't need the test.

"Of course, you have to pass the qualification test to be listed on the QPL. Another important thing is that all screening, qualification, and quality conformance testing must be performed at a test laboratory which has laboratory suitability from DESC-EQE for the particular test method and test condition. The laboratory suitability has to be for the specific test method and test condition."

Figure 3.

QUALIFICATION TESTS

PART I LISTING, QUALIFIED PRODUCTS LIST (QPL) 38510D

1. FULL QUALIFICATION
*2. DIE RELATED QUALIFICATION
*3. QUALIFICATION BY EXTENSION
4. OTHER LEAD FINISHES

PART II LISTING, QPL-38510D

* QUALIFICATION NOT ALLOWED BETWEEN TECHNOLOGY GROUPS OF APPENDIX E (4.4.2.5, MIL-M-38510D)

"There are two types of qualifications for QPL listing: A Part I listing and a Part II listing. The Part I listing is for the parts that have passed all the environmental tests and electrical tests. The Part II listing for Class B is for 22 devices that have passed the electrical tests. No environmental tests are required. The Part II test is to verify that your dice meets the electrical requirements. However, for Class S the 22 device testing for Part II does not apply. We will get into Part II listing requirements a little later.

"You cannot perform die related qualification and qualification by extension between technology groups. This means that if you qualify a linear product, you cannot use this qualification for die related qualification or qualification by extension to a CMOS product or to a TTL product. So you have to review the technology groups in Appendix E (4.4.2.5., MIL-M-38510D)."

Figure 4.

TO RECEIVE CLASS S QPL-38510, PART I LISTING

1. FULL QUALIFICATION (NOT QUALIFIED FOR CLASS B PART NUMBER ON QPL-38510, PART I) (3.1.1b, METHOD 5005, MIL-STD-883B)

   A. FORM TWO SEPARATE CLASS S INSPECTION LOTS (INSPECTION LOTS IL_1 AND IL_2).

   B. PACKAGE TYPE AND DEVICE TYPE IN IL_1 = PACKAGE TYPE AND DEVICE TYPE IN IL_2.

IL_1 → SCREENING METHOD 5004 → GROUP A METHOD 5005 → GROUP B (CLASS S) METHOD 5005 → LOT 1 SAMPLING PLAN → GROUP D METHOD 5005

IL_2 → SCREENING METHOD 5004 → GROUP A METHOD 5005 → GROUP B (CLASS S) METHOD 5005 → LOT 2 SAMPLING PLAN

"If you have no product listed on the QPL, how do you qualify the product?

"First of all, you must form two Class S inspection lots: Inspection Lot 1 (IL_1) and Inspection Lot 2 (IL_2). These two inspection lots must come from two separate wafer lots. This is for qualification.

"Also, the package type and device type in each of the inspection lots have to be identical. You cannot have a flat pack in Wafer Lot 1 and a DIP in Wafer Lot 2 for these tests.

"IL_1 goes through screening, Group A and Group B tests. There are two types of Group B: a Class S, Group B and a Class B, Group B. The devices have to go through the Group B, Class S tests.

"For the Group B, Class S tests, there are two sampling plans. Lot 1 has to go through the Lot 1 Sampling Plan. Lot 1 Sampling Plan is a tighter sampling plan than the Lot 2 sampling plan.

"Also in Inspection Lot 1, the devices have to be subjected to Group D, environmental tests. It has to be proven that the package will meet the environmental requirements (i.e., salt atmosphere and moisture resistance.)

"Inspection Lot 2 is similar to Inspection Lot 1, except that the Lot 2 sampling plan is looser than Lot 1. The whole idea of this is to prove that you have the capabilities to process two lots which can pass the applicable tests.

"You do not have to perform the Group D tests on Inspection Lot 2."

Figure 5.

TO RECEIVE CLASS S QPL-38510, PART I LISTING (CONTINUED)

2. DIE RELATED QUALIFICATION (QUALIFIED FOR CLASS B PART NUMBER ON QPL-38510, PART I) (3.1.1.a, METHOD 5005, MIL-STD-883B).

   A. PARAGRAPHS "1.a" AND "1.b" ABOVE APPLY.

   B. PACKAGE TYPE AND DEVICE TYPE FOR IL_1 AND IL_2 MUST BE IDENTICAL TO QUALIFIED CLASS B PART NUMBER.

   C. PACKAGE TYPE AND DIE MUST MEET CLASS S REQUIREMENTS.

   D. FLOWS FOR IL_1 AND IL_2 IN PARAGRAPH 1 IS THE SAME EXCEPT GROUP D TESTING NOT REQUIRED.

"If you have a particular part number listed on the QPL, Part I for Class B, and you wish to receive Class S qualification for this part number, what do you have to do?

"First of all, the two inspection lots which we discussed previously must be formed. The parts must be subjected to the tests that we showed before.

"IL_1, package type and device type, and IL_2, package type and device type, must be identical to the package type and device type qualified on Part I. And what we mean, is that is you qualified a 14 pin dip white ceramic package which has a solder seal, and so forth, then the Class S package has to be this package. Also, it must be the same device type with the same die.

"And again, the package type must meet the Class S requirements. You may not be able to use a part number on Part I, and a particular package listed on Part I for Class B, for Class S qualification because the package qualified may have a glass frit seal (black ceramic) with the leads extending through the glass seal. This is not allowed for Class S. Therefore, be sure that the package type meet the Class S package requirements.

"The die must also meet Class S requirements. The die listed on Part I for Class B may not meet the Class S requirements. Therefore, the die Class S requirements must be taken into consideration (i.e., the minimum metalization thickness).

"The one set of tests that you do not have to perform again is the Group D tests. You have already proven that the package will meet the Group D tests. If the particular package has already passed the environmental tests, why do them again?"

Figure 6.

	PACKAGE TYPE	PACKAGE TYPE
MIL-M-38510D	C	D
DEVICE TYPE	14 PIN DIP	14 PIN FP
M38510D/00101	FQ	
M38510D/00201		FQ
M38510D/00301	DR	

"We will explain the full qualification, die related qualification a little more fully.

"For example, suppose you perform the full qualification (FQ) tests on a 14 pin DIP M38510/00101 device. FQ means you have performed all the electrical tests and all the environmental tests.

"Suppose you also have performed all the full qualification tests on the M38510/00201 device in the D package. Again all the electrical and all the environmental tests were performed. You have proved that the package (package D) with the particular die, M38510/00201 die, can meet all the test requirements. Now you can start talking about the die related tests. You can perform only the die related tests, for example, with the M38510/00301 die in package C because you have already proved that the package C will meet the environmental requirements. So why do the moisture resistance and the salt atmosphere tests again? Therefore, you have to perform only a die related test to have the part listed on the QPL.

"Also, we have what is called qualification by extension. You have already tested the package and have already tested the die, so why not receive qualification by extension? However, there are certain requirements you have to meet to receive qualification by extension.

"So if you have M38510/00101 products listed on Part I in a D package type, you can receive qualification by extension without any further testing if you meet certain requirements.

"Look at this matrix. You can have the M38510/00201 part listed by extension because you have already tested the package and the die. So essentially you can have all six parts in the matrix qualified if you meet certain requirements. There are the requirements:

Figure 7.

PART I LISTING, QPL-38510D

3. QUALIFICATION BY EXTENSION - IS ALLOWED IF:
(4.4.2.5.2, MIL-M-38510D)

A. IDENTICAL DIE MASKS

B. OPERATING JUNCTION TEMPERATURE TJ AT RATED POWER AT MAXIMUM OPERATING TEMPERATURE FOR NEW DIE/PACKAGE TYPE COMBINATION DOES NOT EXCEED TJ (MAXIMUM RATING SPECIFIED) MINUS 10°C.

EXCEPTION:
NEW DIE/PACKAGE TYPE COMBINATION EXCEEDS TJ MINUS 10°C.
GROUP B-5, METHOD 5005, MIL-STD-883B

C. PACKAGE TYPE PREVIOUSLY QUALIFIED.

EXCEPTION:
NEW DIE AREA IS LARGER THAN DIE AREA PREVIOUSLY QUALIFIED IN APPLICABLE PACKAGE TYPE. GROUP B-6 METHOD 5005, MIL-STD-883B.

EXCEPTION:
PACKAGE TYPES NOT PREVIOUSLY QUALIFIED. GROUP D, METHOD 5005, MIL-STD-883B

"A. Identical die masks. The die mask for the 14 pin dip may not be the same as the die mask for the 14 pin flat pack for certain reasons.

B. Operating junction temperature requirements.

C. Package type previous qualified.

"Suppose your part does not meet the operating junction temperature and you want to have qualification by extension on the part. What do you have to do? You have to perform the Group B-5 tests, which are essentially life tests. You may have had the package type previously qualified bu it may have been with a smaller die. Now you may have a different device type with a larger die in the package. What will happen to the die when you perform certain environmental tests, such as constant acceleration?

Therefore, you must prove, for example, that the die will not fly off. And, of course, if the package type is not previously qualified you have to perform the Group D tests, which are all environmentals."

Figure 8.

PART I LISTING, QPL-38510D

4. QUALIFICATION OF OTHER LEAD FINISHES.

GROUPS B-3, D-3, D-5. (4.4.2.5.4, MIL-M-38510D)

A. PACKAGE TYPE MUST BE QUALIFIED.

B. TEST SINGLE DEVICE TYPE WITH NEW LEAD FINISH.

NOTE: QUALIFICATION OF NEW LEAD FINISH ON THIS PACKAGE TYPE MAY BE GRANTED FOR ANY DEVICE TYPE LISTED ON QPL-38510D IF REQUESTED

"There is qualification of other lead finishes. Suppose you have a particular package qualified (i.e., a 14 pin dip with tin plated leads) and you would like to qualify solder dip leads. What do you have to do? All you have to do is test one device type with the new type of lead finish. You would have to perform certain tests (i.e., tests, solderability, salt atmosphere). Once you qualify the new lead finish on the particular package, you can receive qualification for that lead finish on every device type in that package which is listed on the QPL. "

Figure 9.

TO RECEIVE CLASS S QPL-38510D, PART II LISTING

1. QUALIFIED FOR CLASS B PART NUMBER ON QPL-38510D, PART I (20.2, APPENDIX D, MIL-M-38510D)

2. PACKAGE TYPE AND DIE TYPE MUST MEET CLASS S REQUIREMENTS.

3. SEND FOLLOWING INFORMATION TO DESC-EQE:

   A. REQUEST CLASS S, QPL-38510D, PART II LISTING. MUST BE FOR DEVICE TYPE AND PACKAGE TYPE QUALIFIED IN PARA 1.

   B. QUALIFICATION TEST PLAN FOR METHOD 5005, MIL-STD-883B

   C. BURN-IN/LIFE TEST SCHEMATIC

   D. APPLICATION FOR QUALIFICATION TEST, DESC FORM 36A

"How do you receive Part II listing? I think this is of the most interest for the part manufacturers here. Again, we have to have the Class B part number listed on Part I (we are talking about the package type and the die) and the package type and the die must meet the Class S requirements. For example, glass frit with the leads sticking out of the sides are not allowed. All you have to do is:

1. Request the listing.

2. Send us a test plan showing how you are going to perform the tests for the Part I listing.

3. Send us the burn-in/life test schematic if it is different than previously submitted. If it is the same, just tell us so then it doesn't have to be resubmitted.

4. Send in an application for qualification testing.

5. The only way to be listed on Part II is with the understanding you are going to try to qualify your part for Part I listing. Therefore, you also have to send an application to test."

Agenda Item 7.

Part Types of Current and Future Interest. . . . L. Hamiter, NASA/MSFC
A. Borofsky, The Aerospace Corporation

Mr. Leon Hamiter, NASA/MSFC, identified the devices that NASA is standardizing in their standard parts program. He said they were requiring NASA contractors in new projects starting with the Space Telescope Program and others to use the NASA Standard Parts List. He pointed out the following:

"This list shows the items that are now on MIL-STD-975 and the items being considered as candidates to go on MIL-STD-975; so these are the parts that we are vitally interested in getting someone on Class S QPL so that the users will readily have a supplier for the parts.

"You should all be familiar with MIL-STD-975 which is the NASA Standard Parts List as this time. And I'm going to talk primarily about Grade 1 because Grade 1 in microcircuits is synonymous with Class S. This list does have a Grade 2 listing in it, but Grade 2 is for noncritical equipment. Grade 1 is for very critical equipment.

"The items that are already on the MIL-STD-975 are the A-series of CMOS. I'll not go through all the numbers here, they are in the handout." (The three pages which follow.)

"Some of you may not be aware, these parts (12 different sets of B series, CMOS devices) are now being covered by slash sheets to MIL-M-38510. They are in the slash 170 series. Specification 170 through slash 182 will cover the 12 different sets of B series, CMOS devices.

"Some of you have participated in coordination meetings on 170. DESC has the draft on 170 through 174 to send out now for your comments. We have a schedule for preparing the others, which should all be out by mid- to late 1978.

"We are interested in part manufacturers moving ahead to get Class S qualified for the devices we see on this list."

Mr. Arnold Borofsky, The Aerospace Corporation, gave some visibility on the part numbers and technologies that SAMSO and The Aerospace Corporation are interested in seeing Class S sources on.

"What we have here is a draft of part types that are used on the major technology families. You will note if you compare the list which was just presented by Leon Hamiter, NASA/MSFC, that almost all of those parts do appear on this list. There is a high degree of commonality involved here.

"There is an intense effort underway to come up with a preferred portion of what we are going to present to you. In this case we do need the manufacturing industry to help. In fact, some of you have already been asked to give us some input. What we would like to do is to cut down the numbers of part types that are being shown to you to a manageable few that will fulfill the functional needs. We will start with what Leon Hamiter presented as a starting point, but we may have to expand our list. We do need an input from you part manufacturers.

"We are attempting to accomplish this by the end of the first quarter. We are also asking contractors for their help in the standardization approach. We'll get back with all of the interested part manufacturers here today with these lists as we modify them for your continuing comment in this regard.

"We are not presenting anything here today except the TBD (To Be Determined) relative to the LSI types of microprocessors, and so forth. The reason for that is that most of these items are not on the computer. To use what I had, I would give you a disproportionate view of really what life is. There are microprocessors, RAMS, interfaces, and all kinds of specials which are currently being designed in. We will have that available to you in the near future.

"Here is a list of all the CMOS devices that are currently being used in the program. Most of these are A's. I have left off the five-digit ones because we aren't prepared to talk about them.

"Similarly on LS we have a great representation of product availability which is being used. It is our intention, as far as digital circuits are concerned, to limit the preferred list to the CMOS and LS families.

"These lists show the other standard TTL. There are a fair number of types which are used.

"This is a large variety. Our task of trying to develop a standard preferred list for the newer programs is one of essentially taking this list and with manufacturers' and contractors' inputs coming up with a list which we can call our preferred list. We are working actively in this area and we will be communicating with you on what we have on this chart as we get this work completed."

(Reproductions of the vu-graphs presented by Mr. Hamiter are given in pages 1 through 3 which follow; reproductions of the vu-graphs presented by Mr. Borofsky are given in pages 4 through 6 which follow.)

L. HAMITER
NASA/MSFC

NASA STANDARD MICROCIRCUITS - GRADE 1 (CLASS S)

APPROVED

CMOS - A-SERIES

GATES - 4011A, 4012A, 4023A, 4000A, 4001A, 4002A, 4025A, 4019A, and 4007A

BUFFERS - 4009A, 4010A, 4049A, 4050A

FLIP-FLOPS - 4013A, 4027A

COUNTER/DRIVERS - 4017A, 4018A, 4020A, 4022A, 4024A

SHIFT REGISTER - 4006A, 4014A, 4015A, 4021A, 4031A

CANDIDATES

CMOS - B-SERIES

GATES - 4081B, 4082B, 4071B, 4072B, 4070B, 4086B

ENCODERS/DECODERS - 4532B, 4555B

BUFFERS AND INVERTERS - 40109B, 4502B

CANDIDATES

MULTIVIBRATORS - 4096B, 40174B

LATCHES - 4099B, 4508B

SCHMITT TRIGGERS - 4093B, 40106B

MUX/DEMUX - 4097B, 40257B

REGISTERS - 4094B, 40100B, 40105B

COUNTERS - 40161B, 40193B

ARITHMETIC CIRCUITS - 40101B, 40181B, 4527B

LPSTTL AND STTL

FLIP-FLOP - 54LS114

GATES - 54LS02, 54LS27, 54LS266, 54LS51, 54S86

SHIFT REGISTERS - 54LS195, 54LS395

DECODERS - 54LS42

ARITHMETIC UNITS - 54LS181, 54S182

DATA SELECTORS/MUX - 54LS153, 54S151

COMPARATOR - 54LS85

SCHMITT TRIGGER - 54LS132

MULTIVIBRATOR - 54LS123

COUNTER/DRIVERS - 54LS290, 54S140

LINEARS

741, 108A, 723, 710, 118, 102, 2700, 2520

ANALOG SWITCHES

DG 140A, 191A, 301A, 501A

MICROPROCESSORS AND PERIPHERAL

CMOS - 1802, 1821, 1822, 1823, 1831, 1852, 1853, 1856, 1857, 1859

TTL - 2901, 2902, 2905, 2909, 2914, 2918, 29720, 54LS214

I^2L - SBP 9900, SBP 9818, SBP 9753

A. Borofsky
The Aerospace Corporation

SAMSO CANDIDATE CLASS S PARTS

- DRAFT List: COMPOSITE OF PARTS USED BY MAJOR SAMSO PROGRAMS CURRENTLY UNDER CONTRACT.
- HIGH DEGREE OF COMMONALITY WITH NASA LIST.
- FULL COORDINATION AND FINALIZATION OF THIS LIST IS PLANNED TO OCCUR IN 1st. QUARTER 1978.
- A CONCENTRATED EFFORT IS UNDERWAY TO ADD LSI DEVICES TO THE LIST.

CMOS

4000	4023	4053	4532
4001	4024	4061	4539
4002	4025	4063	4555
4004	4027	4066	4556
4006	4030	4067	
4007	4031	4068	
4008	4032	4069	
4009	4035	4071	
4010	4036	4073	
4011	4037	4075	
4012	4040	4078	
4013	4041	4081	
4014	4042	4096	
4015	4043	4098	
4016	4044	4502	
4017	4046	4508	
4018	4047	4512	
4019	4049	4514	
4020	4050	4515	
4021	4051	4516	
4022	4052	4520	

54LS

00	42	124	165	242	395
02	51	125	166	243	
03	54	132	169	251	
04	55	138	173	253	
05	73	139	174	257	
08	74	145	175	258	
10	75	148	181	259	
11	83	150	182	266	
12	85	151	190	273	
13	86	153	191	279	
14	90	154	192	280	
20	92	155	193	283	
21	93	156	194	293	
22	95	157	195	295	
26	96	158	196	298	
27	107	160	197	365	
30	109	161	198	366	
32	112	162	221	367	
37	122	163	240	368	
40	123	164	241	393	

54

00	25	70	112	163	298
01	26	72	116	164	366
02	27	73	120	165	367
03	30	74	121	166	368
04	32	75	122	173	564
05	37	76	123	174	
06	38	77	125	175	
07	40	79	132	180	
08	42	80	145	181	
09	43	82	148	182	
10	44	85	150	183	
11	45	86	151	193	
12	46	90	153	195	
13	47	91	154	196	
14	48	92	156	197	
16	49	93	157	198	
17	50	95	159	202	
20	51	96	160	265	
21	53	97	161	271	
23	54	109	162	279	

54L

00	43	74	121
01	44	78	122
02	46	85	123
03	47	86	138
04	51	89	154
10	54	90	164
12	55	91	165
20	71	93	193
30	72	95	
42	73	98	

54S

00	37	133	174	258
02	40	134	175	260
03	51	136	181	280
04	64	138	182	288
10	65	140	188	472
11	74	151	189	473
20	86	153	194	481
22	109	157	195	482
30	112	158	251	
32	113	163	257	

LINEARS

555	545140	109
556	55107	110
710	55108	111
711	55113	118
723	55114	140-X
741	55115	2108A
747	101A	2520
3045	102	2600
7831	106	2700
7832	108A	

MEMORY DEVICES
MICRO PROSSESORS
INTERFACE CIRCUITS
SPECIALS

T. B. D.

Agenda Item 8.

Responses to submitted questions. . . . . .W. Aston, The Aerospace Corporation

Mr. Bill Aston, The Aerospace Corporation, pointed out that in the meeting invitation letter it was requested that questions on the new Class S space parts documentation be submitted in advance. He said he had received a significant number of questions, which together with answers, were grouped into four categories: general questions and answers, which were those questions that did not pertain specifically to any one of the three documents, and those questions directed specifically to one of the three documents: MIL-M-38510D, DESC-EQE-44, or MIL-STD-976.

These submitted questions were presented and discussed, and answers are reproduced in the pages which follow and in the ensuing sequence: general, MIL-M-38510D, DESC-EQE-44, and MIL-STD-976.

Subsequent to this meeting, SAMSO and NASA have recommended certain changes to MIL-M-38510D and MIL-STD-883B. Refer to Appendix C.

GENERAL

QUESTION 1

We interpret the requirements for S level certification as applying continuously for all product run in those certified areas. However, elements of S level qualification and processing noted in MIL-M-38510D, MIL-STD-976 and DESC-EQE-44 which specifically apply to qualification and processing for "S level only' will only be applied to those specific S level devices being processed. Other items built on those same assembly lines will not necessarily have the same constraints applied. We would like confirmation that these latter assumptions are correct.

ANSWER 1

Exact duplication of S controls is not intended when non-S product is being produced. The specific differences which you intend to use for non-S product should be identified in your baseline process documents. The degree of difference should be such that adverse impact to JAN's product cannot occur.

QUESTION 2

In the Class B market, it took several years before the use of Class B JAN product became mandatory. Is the Government taking any measures to shorten the transition period for Class S product?

ANSWER 2

Yes, Class S is SAMSO policy. As soon as Class S parts are on the QPL, they will be required for new procurements.

QUESTION 3

During this transitional period, what will be the Government's procurement policy in obtaining product when there are no qualified parts or slash specs in existence? What priority will be established for "S equivalent" and/or "monitored line" during the interim?

ANSWER 3

Class S is SAMSO/NASA policy. Class S equivalent will be procured until Class S parts are on the QPL.

QUESTION 4

Can the Class S market be identified at this time?

ANSWER 4

We will try to develop the market data. This will be further amplified in a later answer.

QUESTION 5

What is the Government's current position on the joint certification team concept for both Class B and Class S?

ANSWER 5

Class B certification is the responsibility of the Defense Electronic Supply Center. Class S is a joint responsibility of SAMSO, DESC, and NASA; however, Class S certification includes Class B certification.

QUESTION 6

When will the finalized certification requirements and guidelines be made available to industry?

ANSWER 6

The certification requirements were released in October 1976. The guidelines will be available in January 1978.

QUESTION 7

When will the certification team begin Class S audits and what criteria will be used for establishing priorities concerning visits to the various manufacturers' facilities?

ANSWER 7

The class audits will be started in January 1978. The priorities are assigned based on NASA and SAMSO needs, the company's readiness for certification, and the companies which apply.

QUESTION 8

Whom do we contact to schedule an audit?

ANSWER 8

Defense Electronics Supply Center.

QUESTION 9

Although not presently a Class S requirement, 100% nondestruct wire pull is being invoked by Government contractors in association with Class S procurement. What is SAMSO, et al.'s present and future position with respect to nondestructive wire pull?

ANSWER 9

The 100% nondestructive wire pull is not required by MIL-M-38510D. While conceptually any 100% test is better than sampling, we are not satisfied that equipment and techniques are universally available to make 100% nondestructive bond pull testing cost effective for all applications.

QUESTION 10

Generally speaking, we feel that somewhere in the Class S procedures the specific issue of manufacturers' exceptions, as they may relate to their particular product, should be addressed. That is, there should be a way to specify in the Class S documentation, a method wherein a manufacturer can formally explain and justify reasonable departures from the exact specified flow when said manufacturer can clearly demonstrate to all parties concerned that the intent of the Class S procurement will still be met. Some examples could involve the time, temperatures, and electrical conditions of burn-in. Combination of AC/DC temperature testing, certain aspects of environmental

screening or assembly conditions, or tolerance variations related to a specific process (e.g., method 5007 limits as applied to a different wafer isolation process).

ANSWER 10

No.

QUESTION 11

Will SAMSO, et al., continue to allow its contractors to procure hi-rel parts to various hi-rel screening/test requirements from manufacturers who do not have line certification? If so, what is the estimate of how much longer this practice will continue? Does SAMSO, in fact, have a time table under which they are operating when they anticipate procuring all relevant components exclusively from certified lines? If so, will they share that time table with the manufacturing community?

ANSWER 11

SAMSO intends to promote the use of qualified MIL-M-38510D, Class S parts from certified lines by all of its programs and contractors. Qualified Class S parts will be added to SAMSO preferred parts list and, therefore, preferred over non-Class S parts.

QUESTION 12

What will SAMSO do in the event of a conflict between the potential availability of a device which offers superior system performance, but is only available from a manufacturer or manufacturers who do not have line certification?

ANSWER 12

If the program design requirements were such that superior device performance were essential and time constraints prevented qualification to the full Class S requirements, SAMSO would procure the parts to requirements equivalent to Class S.

QUESTION 13

Will SAMSO, et al., comment on the component manufacturers' argument that it is extremely difficult to meet all requirements of Class S flow and certification on fabrication lines that simultaneously produce standard products for commercial and industrial applications?

ANSWER 13

We did not anticipate that commercial and Class S products could be intermingled in the assembly and test areas; however, they may be compatible in the wafer fabrication area.

QUESTION 14

What are SAMSO, et al.'s contingency plans in the possible event that there may be certain necessary components which are simply not available with Class S flow from a certified Class S line?

ANSWER 14

We would attempt to buy to requirements as close to Class S as possible.

QUESTION 15

How does SAMSO, et al., intend in the future to outline its general hardware requirements so that manufacturers can objectively assess market potential and make the necessary decisions to resolve whether pursual of Class S business certification, etc., is a business strategy in which they can justify participation?

ANSWER 15

SAMSO/AW plans to forecast the market to the best of its ability recognizing evolving technology, program uncertainty, etc. We will also be relying on contractor and manufacturer inputs. This information will be disseminated as soon as available. We are encouraging manufacturers to obtain Class S certification and qualification of those devices for which they foresee space or launch vehicle applications.

QUESTION 16

If a package has more than 18 pins, is rebonding permitted?

ANSWER 16

No.

QUESTION 17

Is x-ray required prior to final electrical?

ANSWER 17

The x-ray tests may be performed in any sequence after serialization.

QUESTION 18

Is the 250°C, 240-hour accelerated life test required?

ANSWER 18

Paragraph 3.8.2 of Method 5005.4 of MIL Standard 883B provides an alternative to the 250°C accelerated life test.

QUESTION 1

There are indications that Par. 4.1.1.1 of MIL-M-38510D really applies only to the conventional or Kilborne style flat pack. We feel that the wording of that paragraph should be clarified to make that applicability totally defined if that is what is desired.

ANSWER 1

Applies to metal flat packs which contain glass-to-metal seals.

QUESTION 2

At present, Par. 3.4.1.2.5 of MIL-M-38510D states that line certification reaudit frequency is to be negotiated between the manufacturer and the qualifying activity. We feel that in the interest of standardization a specific period should be established. We suggest every year that this audit should be done by a joint team composed of DESC, SAMSO, and NASA. This certification should also suffice for customer certification requirements of MIL-Q-9858.

ANSWER 2

Normally every two years. Maintenance visits (spot check) schedule will be determined and coordinated with the manufacturer.

QUESTION 3

Par. 4.1.4 of MIL-M-38510D indicates that there are mandatory Government source inspection surveillance points. We feel that the whole question of "surveillance" must be clarified. We interpret "surveillance" to mean that Government inspectors can observe those areas listed in Par. 4.1.4. However, these surveillances will not be a mandatory inspection gate. If 100% mandatory inspection gates were intended by Par. 4.1.4, there would be major cost and schedule impacts on devices supplied to those requirements. Additionally, discussions with Defense Contract Administrative

Service (DCAS) indicate that their current staffing levels are totally inadequate to support 100% mandatory inspection points especially on an around-the-clock manufacturing basis. It would be most difficult for DCAS to upgrade their staffing levels sufficiently to cover a program of the anticipated scope of Class S.

ANSWER 3

The language in this paragraph is enabling. The actual level of inspection which will be performed will be as specified in the contract in the case of CSI or letter of delegation in the case of DCAS.

QUESTION 4

Par. 4.1.4 of MIL-M-38510D further mentions a requirement for Government surveillance in fabrication areas. Due to the highly proprietary and sensitive nature of wafer fabrication, we will not allow any source inspection in the fabrication areas. We feel that adequate surveillance is maintained by means of the yearly line certification and our own continuous internal quality audits.

ANSWER 4

Government surveillance is not required in the wafer fabrication areas. Lot acceptance may be done in a separate designated area.

QUESTION 5

Par. 3.4.6.1 of MIL-M-38510D indicates that wafer fabrication records must remain with material throughout the processing cycle. Again, due to the highly proprietary nature of such data, we would not allow that material to freely flow with the devices throughout their processing cycle.

ANSWER 5

It is not necessary for the wafer fabrication records to accompany the lots throughout the entire process including assembly; however, lot identity is required and records should be maintained so as to demonstrate conformance to all of the process baseline steps. A separate traveler identifying the diffusion lot may be used in the assembly areas.

QUESTION 6

Par. 4.3.6 of MIL-M-38510D imposes a requirement for verification of electrical equipment prior to each use. We feel that the requirement as presently stated tends to be vague. We would propose that it read, "electrical test equipment shall be verified prior to the electrical testing of each separate device type through 25°C testing of one correlation sample."

ANSWER 6

The equipment must be checked prior to use for its intended purpose. Correlation samples may be used to verify proper equipment functioning.

QUESTION 7

Par. 4.6.1.2.1 requires that failure analysis be performed on all catastrophic rejects. We feel that the failure analysis should only be required when catastrophic rejects exceed 3%. Failure analysis of a single reject usually proves to be statistically inconclusive and of little real value.

ANSWER 7

Failure analysis is necessary even on individual devices as potential reliability problems may be uncovered. The failure analysis may be limited to a quantity and degree sufficient to establish failure mode and cause.

QUESTION 8

Par. 4.6.1.2 of MIL-M-38510D states that a supplier cannot perform burn-in other than that specified. We strongly feel that there are technically justifiable reasons for utilizing a "pre-burn-in" as a standard in process test for some product families. For example, some linear devices are inherently prone to early parametric drift followed by stabilization of those parameters. By performing this "pre-burn-in", these linear devices are moved into a region of parametric stability. We further propose that it be specifically mentioned in the individual slash sheet for a device when and under what conditions this "pre-burn-in" is allowed.

ANSWER 8

Pre-burn-in is not permitted. If certain stresses are required as part of the manufacturing process the reasons for this must be reviewed by the certification team.

QUESTION 9

Par. 3.5.1 of MIL-M-38510D prohibits sealing temperatures below 750°C, which in turn disallows use of the very reliable solder glass seal package. It is our understanding that this requirement was imposed to eliminate use of those packages with potentially high moisture content. What moisture content level, if any, would be acceptable to the Government such that the 750°C requirement could be deleted?

ANSWER 9

The 750°C requirement was based on the results of the Class A coordination meeting which was held in Washington. This requirement was instituted to preclude a number of known failure mechanisms. We are studying other ways to specify high reliability packages. Additional inputs will be most helpful.

QUESTION 10

Par. 3.5.1 of MIL-M-38510D prohibits the use of desiccants for Class S product. Newer desiccants and the methods of using them have solved the problems normally associated with desiccants and therefore we question the justification for this restriction.

ANSWER 10

If the desiccants are not properly activated, they may emit moisture. We are unaware of any totally reliable method of using desiccants. If the packaging is done properly, dessicants should not be needed.

QUESTION 11

3.1.3(B) limits the inspection lot size for Class S to 600 devices at serialization. With today's equipment, a single operator can process in excess of 1500 devices on a single machine during a single day for all assembly operations. Our recommendation is to eliminate the numerical restriction on lot size and limit lot sizes by the number of devices which can be processed by one operator on a single machine during a single day.

ANSWER 11

In principle we agree, but there are other considerations such as sample size and accept/reject levels. The original 600-piece size was based on our assessment of a single operator, single shift production. We must reassess the considerations applicable to determination of the inspection lot size for Class S.

QUESTION 12

What is the rationale for precluding Class S from the alternate screening procedures of Method 5004?

ANSWER 12

We are not satisfied that the alternate screening procedures are equivalent.

QUESTION 13

Reference Par. 3.1.3.6 regarding lot size requirements. We foresee the occasion, particularly as it involves fabrication of LSI type devices, where the operational time frame restrictions governing lot sizes as specified in this paragraph will result in impossibly small quantities of units to handle with reasonable logistics through additional testing and screening. Can we not find a way to satisfy the common processing traceability required, yet preclude the very real potential of 1 to 10 piece lot sizes?

ANSWER 13

This problem appears to be exceptional. We recognize that some types of LSI devices may require changes in some of the provisions of MIL-M-38510D.

QUESTION 14

Reference Par. 4.6.3 regarding PIND testing. The conductive particulate contamination problem is one which must be eliminated from hi-rel components. PIND testing represents to date the best available screen for this type of defect, but its limits of sensitivity and effectivity are still subject to imprecision. PIND should be utilized 100%, and the recommended flow is potentially a reasonable place to start, but why can't we maintain, at least until more working experience is gained, flexibility in judgment of actual results on a lot-by-lot basis? For example, shouldn't it be allowable for a manufacturer to conduct an actual failure analysis of failing devices, potentially subject to a materials review board (MRB), before final lot/jeopardy lot rejection is imposed on parts per the suggested flow?

ANSWER 14

There will be no changes at this time; however, at a later date changes will be considered in the light of these recommendations. Failure analysis is encouraged.

QUESTION 1

Paragraph 5.3.16 of MIL-STD-976 requires charts of on line bond pull testing data. We propose to keep this information in record form only.

ANSWER 1

Records, if used, should be complete and adequate to show trends over a sufficient period of time. Summaries are desirable; however, the raw data should be available to the certification team.

QUESTION 2

Paragraph 5.3.18 of MIL-STD-976 requires that PIND test records must be maintained on a running average. We would not maintain data in this manner due to the severe logistical constraints. However, we would maintain data for individual lots as required per method 2020 of MIL-STD-883.

ANSWER 2

A running average is not required. Records shall be maintained including package types that are being considered for certification. The certification team will review the latest (3) months records.

QUESTION 3

Paragraph 4.1.3 of MIL-STD-976 is unclear regarding a manufacturer's certification status for level B and C if he loses Class S certification. We propose that a manufacturer be allowed to keep level B and C certification if he meets all requirements for those levels even if he loses his S level certification.

ANSWER 3

The manufacturer will be allowed to keep level B and C if he meets all requirements for those levels.

QUESTION 1

Paragraph 3.1 says that the certification assessment should include but not be limited to all of the items in the check list. We feel that the words "but is not limited to" should be deleted. There should also be an additional sentence which states that additional suggestions may be made over and above what is shown in the check list. But under no circumstances are these to be construed as mandatory requirements imposed upon the manufacturer.

ANSWER 1

The certification guidelines are used by the certification team as an internal document and represents good industry practice. We will use these as a measure of the manufacturer's ability to consistently produce Class S quality parts.

QUESTION 2

On page 2 of the draft, all of the environmental controls should be shown as weekly rather than daily, and should be shown as record rather than chart.

ANSWER 2

Daily checks are recommended for the (3) most critical areas. The balance is weekly. The records, if used, should be complete and adequate to show trends over a sufficient period of time. Summaries are desirable; however, the raw data should be available to the certification team.

QUESTION 3

On page 3 particle count is indicated as a weekly test. We feel this should be monthly. In fact, our records and our data further indicate that we have sufficient control to go bimonthly. Also, all data should be recorded. The last item on that page indicates that the sealing chamber should have a particle count. We feel that this should be changed to lidding station rather than the sealing chamber.

ANSWER 3

The use of the guidelines by the certification team is covered by the answer, A-1, above. Clarification of the terminology relating to "sealing chamber" will be done by the certification team.

QUESTION 4

On page 4, it indicates that resistivity is to be measured daily at the work station and weekly for return water. We feel that this should state "monitored on a 24-hour basis at the discharge" with a requirement for recording daily. Most manufacturers have a permanent meter on their discharge line but are not set up to monitor at the work station. The monitoring of the return water allows adequate assurance when coupled with the monitoring at the discharge. Again, this and the other resistivity measurements should be recorded.

ANSWER 4

The certification team will determine the adequacy of the resistivity measurements.

QUESTION 5

On page 6, there is a requirement for oxide defects monitoring. We perform this on an engineering basis but do not feel it should be done on a lot by lot basis.

ANSWER 5

Monitoring on a lot by lot basis is considered necessary for oxide defects.

QUESTION 6

There is a requirement on page 7 for measurement of photo-resist thickness after the development and post bake. We feel that this is a requirement that is unnecessary and does not add anything to the reliability of the wafers in question. Also, etching temperatures will be verified but will not be recorded.

ANSWER 6

Monitoring the photoresistant thickness on a weekly basis indicates the measure of control afforded by the preceding process steps. Certification is based on an overall evaluation by the certification team. The guidelines will be changed to eliminate the need to record the etching temperature.

QUESTION 7

On page 8, we feel it is totally impractical to perform any of the lot-by-lot tests. Neither these nor the implant depth will be measured. We perform these tests on an engineering basis but do not feel it should be done lot-by-lot.

ANSWER 7

The frequency of these tests will be reviewed for adequacy for Class S certification; however, it is felt that measurements are needed for production control purposes.

QUESTION 8

On page 9, the monitoring of substrate temperature, metallization annealing, and classification composition will be monitored but not recorded.

ANSWER 8

We would prefer to see the data recorded. Variations to the guidelines will be considered by the team.

QUESTION 9

On page 10, the charts should be changed to records.

ANSWER 9

The records, if used, should be complete and adequate to show trends over a sufficient period of time. Summaries are desirable; however, the raw data should be available to the certification team.

Agenda Item 9.

Open discussion. . . . . W. Aston, The Aerospace Corporation,
Lt. Col. K. Blakney, SAMSO/AWSR,
J. Egan, The Aerospace Corporation,
R. Grillmeier, DESC,
L. Hamiter, NASA/MSFC,
L. Murphy, Hq/NASA
A. Borofsky, Aerospace Corp

Bill Aston, The Aerospace Corporation, stated that in the spirit of the meeting, the panel would do its best to answer the questions as frankly and honestly as possible; however, he pointed out that there may be questions for which the panel is not completely sure of the answers or for which the panel is not completely coordinated. He said the panel reserved the right to modify its answers in the published minutes of the meeting.

QUESTION:

"There are systems manufacturers who, for various reasons, do not have full confidence in the JAN program. They practice finding exceptions in existing slash sheets; they specify minor exceptions to avoid use of the QPL system as it exists for a variety of reasons. That type of thing defeats the parts manufacturers' desire to invest in Class S qualification. Are you going to discipline the system well enough to compensate for the dollar investment that has been made? We need assurances that will happen to support the program. Also, what will the customers' market hold for QPL S parts?"

ANSWER:

Leon Hamiter, NASA/MSFC

"I think we all recognize that the in-between period is very difficult. We have to have the in-between period until we get the Class S QPL items. It is a chicken and egg situation that we are dealing with. We are trying to expedite the chicken hatching on out, which is getting on the QPL. The faster we can get it hatched out, the sooner some of these new projects can specify Class S parts. But in the meantime, they will specify to a contractor print. Many contractors would like to order A or S parts. They can't order these parts because they are not available. I don't have a simple answer to your question because there just is no simple answer."

QUESTION:

"It is a long route. And I think by having it a long route it undermines the system because on the two device types, by the time you get your listing, you will already be locked into contractors' control drawings. I think what we really need is a fast route to get to Class S QPL II because you pick up the advantage of everyone performing to a detailed electrical specification, plus you have all the performance requirements, plus you have all the uniformity of marking. I think we ought to re-think what is needed to get in the Class S QPL II, because there are a lot of other things on the negative side which will affect procurement."

ANSWER:

Bill Aston, The Aerospace Corporation

"I think that this is an excellent suggestion and one which will be carefully examined. The real purpose of this meeting is to hear such comments. SAMSO is evolving from the use of a Class B, Class A kind of system which really didn't work very well. The difference between now and before is that we have command level policies from both ourselves and NASA. We have a working relationship with DESC and RADC which we really didn't have before. Consequently, we can make rather rapid changes in requirements once we are satisfied that there is a better course to follow."

QUESTION:

"Who is going to monitor these equivalent 'flows' during the interim time frame?"

ANSWER:

Bill Aston, The Aerospace Corporation

"We will try to get the contractors to do the monitoring. The p rime contractor is functioning under the direction and surveillance of the Air Force program office and The Aerospace Corporation who oversees the contractors."

ANSWER:

Leon Hamiter, NASA/MSFC

"This expedited Class S Part II QPL listing requires constraint, good intentions, and certainly some integrity from both Government and industry. We certainly are willing to consider ways to do it. We don't want to get ripped off by someone who wants to make a quick buck and deliver poor quality products and give us a bad name."

QUESTION:

"It takes a big investment for a supplier to get on the Class S QPL. I think most suppliers are willing to make that investment. Sometimes we have parts in the QPL that don't pay for themselves, parts that we get very little mileage out of. Would SAMSO consider central procurements where SAMSO/NASA would provide incentives by giving manufacturers orders and then stocking the parts for SAMSO/NASA programs? Is SAMSO/NASA contemplating anything like this?"

ANSWER:

Larry Murphy, Hq./NASA

"For the last two years NASA has been studying the possibility of consolidation on an agency basis. The outcome of this review places the program managers right in the middle of a liability situation; consequently, the program managers at NASA centers did not encourage NASA to pursue this course. It is now NASA's policy to encourage program consolidation, such as the Viking program, in lieu of an agency procurement. It would be ideal to get a high rel distributor involved with minimum investment and responsibility by the government."

ANSWER:

Leon Hamiter, NASA/MSFC

"If the legal aspect can be worked out with DESC, NASA is considering ordering some RFQ's on a competitive basis whereby NASA could buy and pay or help pay for the qualification of some of the parts NASA is interested in. NASA may have to overcome some legal or administrative restrictions against the RFQ's."

ANSWER:

Bill Aston, The Aerospace Corporation

"SAMSO and NASA are serious enough about ordering the RFQ's that both SAMSO and NASA have budgeted money in this fiscal year for the Class S parts RFQ's."

QUESTION:

"What would constitute a Class S equivalent certification?"

ANSWER:

Leon Hamiter, NASA/MSFC

"There isn't any Class S equivalent certification. So far, we haven't recognized the DESC drawing as a document for a Class S part. It is very easy for a contractor who is trying to buy an equivalent part to require that nonstandard microcircuits be bought from a line that is line certified. This is what NASA requires. Sometimes NASA has to waive that because there is a new technology that no one has been certified on. But we have had a number of parts for the shuttle program that were bought off of a certified line that didn't have a military or NASA detail specification. The same kind of thing can exist here. I don't see the need for a Class S equivalent certification. Our real need is for some type of equivalency for buying the end item, the part number."

QUESTION:

"In one of the other charts, it was shown that in order to get on the Class S QPL II, a part manufacturer would have to have the Class B qualification. I think that would be OK for many parts that are on Class B now. But new products coming out would not have the Class B qualification. Most of us would not go through two qualifications to qualify the part. I think it will be a long time before new products are on the Class S QPL. How do the two product lines come together?"

ANSWER:

"If a part manufacturer is not on the Part I Class B QPL, then he will not be on the Part II Class S QPL. He can, however, do the testing and go directly on to the Part I Class S QPL."

QUESTION:

"Some parts of these certification guidelines are quite qualitative and subjective. Some items are highly questionable and not clear cut. Also conficts may occur among team members. How will this be handled, and how will it affect the certification? "

ANSWER:

Bill Aston, The Aerospace Corporation

"We have wrestled with the question of how do you grade the report card. We feel that before we get to such a point, if indeed we can, we need some experience. It will be on an individual basis. I might clarify another point. The certification team will not make the final determination as to certification or no certification. That will be made by SAMSO/NASA/ DESC jointly. But not necessarily by the team members themselves. We will review the findings of the team. The purpose of developing the guidelines and making them available to part manufacturers was as Leon Hamiter stated in his presentation. We felt very strongly that part manufacturers should know what the team is looking for, the kinds of things the team is looking at. We are trying the best we can to keep things in the open and where we are talking to one another as responsible people.

"The first Class S audit will be with RCA."

QUESTION:

"Could Question 3, MIL-M-38510D, indicate that for the use of a Class S part on different contracts that you will have different levels of surveillance or inspection?

"If that is the case, how does that contribute to a standard flow where you have one type of processing or one control of processing? Or even stocking and procuring for inventory which I believe is the end result?"

ANSWER:

Lt. Col. Ken Blakney, SAMSO/AWSR

"It is intended we will have a single set of requirements that will be imposed on all prime contractors for this. And once again we will have to manage deviations to them."

QUESTION:

"Does this mean you will have a single letter of delegation as long as that part is on the QPL to infinity, independent of the program it is appearing in?"

ANSWER:

Lt. Col. Ken Blakney, SAMSO/AWSR

"Yes, that is one of the possibilities. It hasn't been negotiated with DLA (Defense Logistics Agency) and so forth."

QUESTION:

"Will that single letter of delegation, assuming it does happen, remain consistent among all manufacturers?"

ANSWER:

Lt. Col. Ken Blakney, SAMSO/AWSR

"It is intended that it would. Once again, we will manage it to the best of our abilities. We are considering here more that the prime contractors will be doing the levels of inspection we are talking about here, rather than delegation to a government agency."

QUESTION:

"We can't overestimate the fact that if you are looking at this as a standard program then ultimately you will have a distributor for stocking. This whole thing is totally unworkable if that is what you are aiming at. People will say that distributor built them to that contract specification and it did not have this or this, therefore I cannot use that. It defeats the whole purpose of the standardized flow, that you have one agreed upon standard flow. What you have is a bunch of custom parts again."

ANSWER:

Lt. Col. Ken Blakney, SAMSO/AWSR

"Not if the standardization was imposed upon the distributor. We are going to try to avoid custom parts."

QUESTION:

"One of the problems that you are going to have is that now you are going to reduce the levels of interpretation to each of the resident CSI inspectors. If we are in trouble with the CSI inspector, he can make our lives miserable. Plus the fact you also then restrict us to his working schedule. If he chooses not to come in on third shift, and we want to run on third shift, then we are stuck. We can only do things when he is available to come in. And this damages our scheduling and everything else. If you leave it as surveillance and enabling, you leave us open to all kinds of abuse."

ANSWER:

Lt. Col. Ken Blakney, SAMSO/AWSR

"I understand your concerns; I am going to try to work those items with the requirements we lay on the prime contractors."

QUESTION:

"If you lay it on the prime contractor and he makes the decision, he is going to CSI instead of GSI. Then you have spoiled the standardization system. We won't be able to do anything. I was discussing the possibility of us going into a stocking program ourselves. We are going to have to depend then upon GSI to do that. And then we are going to be limited by the fact that if the GSI doesn't have delegation, we are going to have to come to you and ask you for permission to make runs for stocking; and say that with no program in mind, you are going to have to authorize delegation through DESC. And then DESC is going to have a problem. They are going to ask if they have money to afford this. You have a problem in the way you are stating this particular item."

QUESTION:

"The problem goes a little further than that. Let us assume we get DCAS surveillance, and we go into a stocking program, and then a prime contractor comes in and says I want to buy parts, but I want CSI on it and precap visual. Is there a major problem in tying down specifically what it is that will be done and then saying flat out that is what it is and saying there is no deviation for any contract?"

ANSWER:

Lt. Col. Ken Blakney, SAMSO/AWSR

"Yes, we are going to attempt to develop the standard set of requirements, which would be laid on the prime contractor and/or delegated to DCAS and that certainly is where we are heading.

COMMENT FROM AN MANUFACTURING REPRESENTATIVE:

"The basic problem is that until you get to that point you are not going to have a program."

QUESTION:

"I understand for Class S, GSI is already imposed upon the inspection--sampling and acceptance. But now you say you are going to take it to the program and let them make a decision on whether they want CSI or GSI when we already have a QPL Class S upon which you said GSI is imposed."

ANSWER:

Lt. Col. Ken Blakney, SAMSO/AWSR

"I don't believe GSI is presently imposed to the degree of Class S. It has to be delegated to DCAS. It is only enabling in MIL-M-38510 so that you know what we are intending. It does not impose it on either DCAS or the contractor. Those are separate actions."

QUESTION:

"In regard to what you say, let's look at Par. 4.1.4, MIL-M-38510D. I think it is very specific on whether GSI is imposed or not."

> 4.1.4 Government source inspection for class S. For each class S inspection lot, government personnel and other government designated representatives (when required by contract or order), will perform surveillance and monitoring functions related to inspections, assembly, and wafer fabrication from wafer lot acceptance through shipment of the completed product.

"It says 'will perform.' It doesn't say 'shall be able to,' or 'may at their option,' or 'shall according to the program.' It says 'will.'

"We assume that GSI is mandatory. I don't see the purpose in having a nonstandard standard part. It you start leaving the option out, and say maybe we'll invoke CSI on it, where is the incentive to get things done in the stocking program?"

ANSWER:

Lt. Col. Ken Blakney, SAMSO/AWSR

"We understand those concerns. We have more homework to do in that area."

ANSWER:

Bill Aston, The Aerospace Corporation

"The key in the answer and what we were attempting to achieve in Par. 4.1.4, is to enable contractor people to perform some of these inspections or monitoring; possibly we didn't state it adequately. Contractor inspections did not exist in any of the previous revision issuances of MIL-M-38510. It always referred to the Government only. The phrase, 'other Government designated representatives' means contractor people.

"What we have tried to achieve is a step in this direction. We just simply can't get to the ultimate or utopia of consolidated buys by NASA and SAMSO for all programs--that just isn't the way the world is structured today. So what we are trying to do is at least to start on the one entity that we think we can come to grips with, and that is the program. Clearly, there is going to be overlap, duplication, and so forth. But our ultimate objective is to achieve a level of product quality demonstrated that other people can believe in and then some of these problems will start to disappear. We have wrestled with this question of having multiple contractors in your plants monitoring essentially the same product line. It is a tough problem. We are trying to take it in the steps we feel we have a reasonable expectation of achieving. We understand you. Try to bear with us. We just can't jump from where we are today to some mythical utopia."

QUESTION:

"Why can't DCAS handle the monitoring?"

ANSWER:

Lt. Col. Ken Blakney, SAMSO/AWSR

"DCAS has not had experience in monitoring Class S product. They would probably have to change their staffing levels. They would need retrained and differently certified inspectors. We have approached DCAS several times and this matter has not been resolved."

QUESTION:

"Can the amount of inspection that is done be standardized? Interpretation on internal specifications varies considerably from Government inspector to Government inspector."

ANSWER:

Jim Egan, The Aerospace Corporation

"We assume the source inspector will apply intelligence in the performance of his duties; he would determine what and how much ne needs to look at."

COMMENT FROM A MANUFACTURING REPRESENTATIVE:

"Certain people will not allow any inspections in the fabrication area. The audit process is well defined as open and accessible. However, if you are talking about even on some random basis that the inspector will go into the fabrication area, you may encounter problems. There is a GO-NO GO gate in some cases. Certain suppliers and processors are so proprietary that they just will back away from an inspector's visit."

ANSWER:

Lt. Col. Ken Blakney, SAMSO/AWSR

"We understand your concerns. They are good suggestions. We will have to sit down and really wring them out."

QUESTION:

"I have a question on measuring moisture content. This requirement is inserted into the requirements of Test Method 5005, MIL-STD-883. It is in there mainly because of the problems of (a) glass frit seal devices which are specifically outlawed for Class S and (b) devices which contain desiccants which are also specifically prohibited for Class S. This requirement is looking at problems which are not relevant for Class S material.

"A second consideration is that measuring moisture content is an expensive proposition for any manufacturer. We have not been able to find any good equipment available at anything close to a reasonable price. Is there any possibility that measuring moisture content can be dropped from the Class S requirements? This is a test method that most, if not all manufacturers, cannot consistently perform even on a sample basis."

ANSWER:

Jim Egan, The Aerospace Corporation

"I personally don't agree with the first part of your statement, that the requirement for measuring moisture was placed in the specification for the reasons you specified. I think the intent of the requirement is to measure the moisture content on all package types that we could procure to a Class S specification."

ANSWER:

Ray Grillmeier, DESC

"Because you part manufacturers don't have the capability to measure moisture content now, here is what we would like to do, if RADC would go along with it. Let RADC accept samples to be measured for moisture content until we find a laboratory that has the capability to do the measuring. Dr. Bob Thomas, RADC, is now checking devices from a particular lot that were shipped both to him and to a laboratory to verify if both he and the laboratory are getting the same type of readings."

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ANSWER:

Arnold Borofsky, The Aerospace Corporation

"There are two pieces of equipment available to measure moisture content. There is a piece of equipment that will measure moisture only, and according to Dr. Bob Thomas costs about $5000. There is a variation of that equipment that can measure both moisture content and other constituents in a package, which costs about $25,000. These newer equipments do not require the expertise of Bob Thomas' older units."

QUESTION:

"In regard to pre-burn-in for linear devices, you mentioned you wanted some data. Is there any specific way any of us should go about giving you that data?"

ANSWER:

Leon Hamiter, NASA/MSFC

"I think it is up to you to look at what kind of data you can give us that justifies your not having an inordinate fallout at a pre-burn-in that in reality represents a reliability hazard to the shipped product. Be flexible, and give us what you think proves that item one way or another. At this particular time, send the information to SAMSO.

"I am anxious to hear proposals for remedying the requirement; not just suggestions to eliminate the requirement because it is a problem.

"Possibly the way to allow pre-burn-in is to leave the wording of the requirement, "pre-burn-in is not allowed unless during line certification adequate proof and justification can be given," or something along those lines. We will have to talk to DESC and RADC and see what they would be willing to do. Detail specifications are a way but if it applies to all linears, the way we ought to handle it is as a category for linears in the general specification.

"The reason pre-burn-in has not been permitted is that we don't think that a production line which builds a product that when subjected to the various screening and controls results in a very low yield is truly a reliable, highly desirable production line.

"Without this particular requirement, you might actually be yielding less than 10%. That wouldn't show up in the regular 240-hour burn-in with a PDA on it. I'm sure there are other kinds of ways we can deal with this requirement, if in being written the way it is, it presents a real problem.

"All we are trying to avoid is a pre-burn-in that throws away a lot of product because it is really unstable product. If you didn't have this requirement and a manufacturer was having trouble passing the PDA of burn-in, then he could do a pre-burn-in just to get him through PDA. But you still wouldn't have the proof relative to 2000 hours, 5000 hours, or 10,000 hours stable performance of the same device.

"This requirement is now in the specification and we will have to take final action with DESC and RADC to change it. The question is that we really need to spend some time to define what is an acceptable technical solution to the problem."

Agenda Item 10.

Closing Remarks. . . . . Col. W. L. Schlosser, SAMSO/AW

Colonel William Schlosser said he was enthusiastic about the turnout to the meeting. He conveyed the best wishes for success from Lt. Gen. Thomas W. Morgan, SAMSO Commander, and Brig. Gen. Patterson, DESC.

He pointed out that the part manufacturers, space contractors, and Government representatives are all part of a team, and that a triangular communication system existed among them.

With regard to the cost of a Class S part, he said,

"About everywhere I have gone that question has come up. Let me say this with regard to General Morgan's feelings. General Morgan is well aware that if we get into Class S and the monitored line concept, as we are going to--and we take it for granted the high quality, high altitude programs managed by NASA Headquarters--we will have items that cost more money. The SAMSO Commander has told me several times that the additional cost does not concern him nearly as much as the mission success we are expecting this is going to buy us. If you put on your taxpayer's hat, and I hope you do all the way through this, we are convinced that the end cost of putting up a spacecraft will be less than it is today when we have a national program. Despite the cost of the Class S going in we are convinced the total cost of the spacecraft after it has performed through its mean mission duration life will cost the taxpayer less money."

Colonel Schlosser concluded emphasizing two points:

"First, I am happy we are talking in a positive way about what we can do, and second, please consider this meeting a beginning of a much more frequent dialogue among Government representatives, part manufacturers, and space contractors."

APPENDIX A

DESC-EQE-44, First Draft, 18 November 1977,
"Guidelines for the Implementation of Class S
Microcircuit Certification"

DRAFT

GUIDELINES FOR THE IMPLEMENTATION

OF

CLASS S MICROCIRCUIT CERTIFICATION

DESC - EQE - 44

FIRST DRAFT, NOVEMBER 18, 1977

DRAFT

FIRST DRAFT
18 November 1977

GUIDELINES FOR THE IMPLEMENTATION OF CLASS S MICROCIRCUIT CERTIFICATION

1. Scope. Provide guidelines to the certification team for the implementation of Class S certification of microcircuit manufacturing facilities.

2. Purpose. Establish a uniform approach by the certification team in the assessment of the manufacturer's capability to produce Class S microcircuits. To this end, the document provides instructions for assessing process control adequacy in the form of recommended limits, applicable test methods, measurement frequency, and records. A checklist is included for the convenient systematic use of the certification team.

3. Instructions.

3.1 All team members are expected to utilize the checklist in the performance of their certification assignments. The team chairman will assign the elements of the certification to team members on the basis of individual expertise. The certification assessment should include, but is not limited to, all of the items in the checklist. Any additional items that are assessed, and the results shall be added to the checklist for record purposes.

3.2 The recommended limits and measurement frequency provided in the checklist are only for guidance and should not be considered hard requirements. Rather, the team is encouraged to assess the adequacy of the manufacturer's control in relation to the processes involved.

3.3 The team should verify that all measuring and test equipment is functioning and calibrated. They shall also verify that test measuring procedures and equipment are sufficiently accurate for the required test.

3.4 The team should typically sample check six months of records for the item being certified. In addition, the location of the equipment and the adequacy of the operating procedure should be checked, and whenever practical, operations utilizing the equipment and procedures witnessed.

3.5 The team should review the process data and limits to establish the percent of time each process is in control. Processes with a history of poor control should be identified for an explanation by the manufacturer and corrective action for improvement. The team should also review how the manufacturer establishes the process control limits and the actions taken when the limits are exceeded.

3.6 The Product Assurance Program Plan and the Manufacturing Flow Chart required by Appendix A of MIL-M-38510D should be reviewed for adequacy and completeness prior to the audit of the manufacturing facilities and should be used as a baseline/reference during the course of the audit.

First Draft
Nov. 18, 1977

ITEM	TEST METHOD	RECOMMENDED LIMITS	MEAS. FREQ.	RECORDS	FINDINGS
1. ENVIRONMENTAL CONTROL (Note 1)					
RELATIVE HUMIDITY		1. PHOTOLITHOGRAPHY: ± 10% (60% MAX)	DAILY	CHART	
		2. ASSEMBLY: ± 20% (56% MAX)	WEEKLY	RECORD	
		3. SEALING CHAMBERS: 20 PPM H_2O MAX (WELDING, SOLDERING. EXCLUDING BELT FURNACES)	DAILY	CHART	
TEMPERATURE		1. CHEMICAL PROCESSING AND PHOTOLITHO-GRAPHIC AREAS ± 3°C	DAILY	RECORD	
		2. OTHER ± 5°C	WEEKLY	RECORD	

ITEM	TEST METHOD	RECOMMENDED LIMITS		MEAS. FREQ.	RECORDS	First Draft Nov. 18, 1977 FINDINGS
PARTICLE COUNT:	(Note 2)	Work Station	General Area			
Mask Making	FED. STD. 209 (Royce or similar instrument)	100	10,000	WEEKLY	CHART	
Spin Photoresist		100	10,000		CHART	
Alignment		100	10,000		CHART	
Develop		500	10,000		RECORD	
Etch		500	10,000		RECORD	
Internal Visual		100	10,000		CHART	
Other Inspection		100	100,000		RECORD	
Epitaxy		100	10,000			
Wafer Clean		100	10,000			
Glassivation		100	10,000			
Oxidation (3)		100	10,000			
Diffusion (3)		100	10,000			
Metallization		100	10,000			
Assembly Die Attach Wire Bond		100	100,000			
Sealing Chambers (where devices are lidded)		100	100,000			

ITEM	TEST METHOD	RECOMMENDED LIMITS	MEAS. FREQ.	RECORDS	FINDINGS
2. CONTROL OF HIGH PURITY WATER	(Note 3)				
RESISTIVITY:	NHB 5300.4 (3D) METHOD 60011B OR ASTM D 1125-64	AT WORK STATION ACT / ABS; RETURN WATER ACT	DAILY AT WORK STATION WEEKLY FOR RETURN WATER	CHART	
BIPOLAR DIGITAL.		12* / 10* / 8*			
BIPOLAR LINEAR.		14 / 12 / 9			
MOS.		16 / 14 / 10			
		* NO^6 Ω/CM at 25°C			
TOTAL SOLIDS	NHB 5300.4 (3D) METHOD 6002A OR ASTM D 1069-66	5 PPM ABSOLUTE	MONTHLY AND AT CHANGE IN H_2O SOURCE	CHART	
BACTERIA COUNT	NHB 5300.4 (3D) METHOD 6004 OR ASTM F60-68	100/100ML ABSOLUTE	WEEKLY AND AT CHANGE IN H_2O SOURCE	CHART	

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ITEM	TEST METHOD	RECOMMENDED LIMITS	MEAS. FREQ.	RECORDS	FINDINGS
3. SUBSTRATES					
THICKNESS	NHB 5300.4 (3D) METHOD 6013B	± .001"	LOT BY LOT	RECORD	
FLATNESS	METHOD 6013D	± .0015"; 2" WAFERS ± .002"; 3" WAFERS			
PARALLELISM	METHOD 6013C	± .0005"; 2" WAFERS ± .001"; 3" WAFERS			
SURFACE ROUGHNESS	METHOD 6018A METHOD 6018B	500A MAX NO VISIBLE ROUGHNESS			
CRYSTAL PERFECTION:	METHOD 6015A/B				
a) DISLOCATION COUNT		500 PITS/CM^2			
b) LINEAGE		1/CM^2			
c) SLIP		1/CM^2			
SURFACE ORIENTATION	METHOD 6012A	± 1/2° OF SPECIFICATION			
CONDUCTIVITY TYPE	METHOD 6017A/B	N OR P			
RESISTIVITY	METHOD 6011A/B	WITHIN SPECIFICATION			

ITEM	TEST METHOD	RECOMMENDED LIMITS	MEAS. FREQ.	RECORDS	First Draft Nov. 18, 1977 FINDINGS
4. OXIDATION					
THICKNESS (Note 4)	NHB 5300.4 (3C) METHOD 6040B, C, OR D		LOT BY LOT	RECORD	
a) MOS GATES AND CAPACITORS		± 10%			
b) OTHER		± 20%			
OXIDE DEFECTS	NHB 5300.4 (3D) METHOD 6052A		LOT BY LOT	CHART	
PINHOLES		$10/CM^2$ (1 μM OR LARGER)			
STABILITY	CV PLOT (Note 5)				
a) THIN OXIDE (~1000A)		ΔFB=0.3V MAX	DAILY	RECORD	
b) THICK OXIDE (~10,000A)		ΔFB=3.0V MAX	DAILY	RECORD	
FURNACE PROFILING (Note 6)					
a) FLAT ZONE		± 2°C	DAILY	RECORD	
b) PROFILE			WEEKLY	RECORD	

ITEM	TEST METHOD	RECOMMENDED LIMITS	MEAS. FREQ.	RECORDS	First Draft, Nov. 18, 1977 FINDINGS
5. PHOTOLITHOGRAPHY					
PHOTORESIST VISCOSITY	NHB 5300.4 (3D) METHOD 602A/B OR ASTM F66-66T	± 3 CPS	LOT BY LOT	RECORD	
SPINNER SPEED	NHB 5300.4 (3D) METHOD 6054A/B OR ASTM 66-66T	± 100 RPM	WEEKLY	RECORD	
BAKE PR a) SOFT b) HARD		± 10°C ± 5°C	DAILY	RECORD	
EXPOSE P.R. a) LIGHT INTENSITY b) TIME	NHB 5300.4 (3D) METHOD 6035A/B	± 10% +1 -0 SEC	DAILY	RECORD	
P.R. THICKNESS	AFTER DEVELOP AND POST BAKE	± 10%	WEEKLY	RECORD	
ETCHING TEMPERATURE		± 1°C	LOT BY LOT	RECORD	

ITEM	TEST METHOD	RECOMMENDED LIMITS	MEAS. FREQ.	RECORDS	First Draft Nov. 18, 1977 FINDINGS
6. EPITAXY					
CHARACTERIZATION	NHB 5300.4 (3D) METHOD 6030A, B, C AND D				
a) THICKNESS		± 10%	LOT BY LOT	RECORD	
b) SHEET RESISTIVITY		± 20%	LOT BY LOT	RECORD	
c) STACKING FAULTS (Note 7)		100/CM^2 MAX.	DAILY	RECORD	
7. JUNCTION					
JUNCTION DEPTH		± 20%	LOT BY LOT	RECORD	
W/I		± 20%	LOT BY LOT	RECORD	
DIFFUSED RESISTORS		V/I ± 10%	LOT BY LOT	RECORD	
ION IMPLANT					
a) V/I		± 5%	LOT BY LOT	RECORD	
b) DOSE (IONS/CM^2)		± 5%	LOT BY LOT	RECORD	
c) IMPLANT DEPTH		± 10%	MONTHLY	RECORD	

ITEM	TEST METHOD	RECOMMENDED LIMITS	MEAS. FREQ.	RECORDS	First Draft Nov. 18, 1977 FINDINGS
8. METALLIZATION					
SUBSTRATE TEMPERATURE		± 25°C	LOT BY LOT	RECORD	
VACUUM (EVAPORATION)		10^{-6} TORR. MAX	LOT BY LOT	GO/NO GO	
COMPOSITION		PER SPEC	MONTHLY	RECORD	
ANNEALING		± 5°C	LOT BY LOT	RECORD	
C/V PLOT		SAME AS OXIDE	DAILY	RECORD	
METAL THICKNESS		± 10% (8,000A MIN., TOP METALS, 6,000A MIN FOR LOWER METALS)	LOT BY LOT	RECORD	
9. GLASSIFICATION					
DEPOSITION THICKNESS		± 20% (6000A MIN)	DAILY	RECORD	
COMPOSITION		PER SPECIFICATION	WEEKLY	RECORD	
10. WAFER THINNING		± 1 MIL (6 MIL MIN)	LOT BY LOT	GO/NO GO	

ITEM	TEST METHOD	RECOMMENDED LIMITS	MEAS. FREQ.	RECORDS	First Draft Nov. 18. 1977 FINDINGS
11. SCRIBING AND DICING					
SCRIBING	MIL STD 976	PARA 5.2.9			
DICING		PARA 5.2.10			
12. WIRE BONDING					
PULL TEST	MIL STD 883 METHOD 2011	2.5 GM FOR 1 MIL AL WIRE 3.0 GM FOR 1 MIL AU WIRE		CHART	
BONDING SCHEDULES	MIL STD 976	PARA 5.2.12 ($T=\pm .5^{o}C$ FOR T.C. BONDS)			
13. DIE MOUNTING					
METHOD	MIL STD 976	PARAS. 5.2.11 AND 5.3.15			
DIE ATTACH STRENGTH	MIL STD 883 METHOD 2019			CHART	

NOTES:

1. Environmental Control:

a. After internal visual, the devices should be maintained in a class 100 laminar flow or inert gas atmosphere and transported in clean, sealed, inert gas filled non-dusting containers free of sodium or other contaminant.

b. The part shall be shielded from spittle or other physiological contaminants (e.g., face mask, plexiglass guards).

c. If wafers are loaded under laminar flow into suitable containers which preclude contaminants from wafers and then loaded directly into diffusion tubes from the containers, the 100 level laminar is not required.

2. Laminar Flow Hoods: The air flow rate of class 100 hoods should be measured at 3 points in the work area. There should be no more than 20 FPM difference between any two readings, with a recommended minimum air flow limit of 90 FPM.

3. DI Water Resistivity: DI water resistivity should be monitored at the work station. Particular consideration needs to be paid to calibration and handling of the resistivity cell. The glass membrane electrode (if used) should soak for at least 10 minutes in DI water prior to recording measurements.

4. Oxide Thickness Measurements: Oxide thickness in the 6000 Å to 12,000Å range are normally measured with a mechanical stylus such as the Talysurf or Dektak. Thinner oxides in the 900Å to 1200Å range are normally measured with an ellipsometer. Once the oxide thickness is calibrated against a time-temperature curve and color charts, the color may be used for process control.

5. CV Plot:

a. Deposit metal dots on oxidized wafer (anneal as appropriate).

b. Run CV plot to establish initial V_{FB} or V_{Th} use 0 to -10 or -20V for P channel and 0 to +10 or +20 volts for N channel.

c. Heat wafer to 300°C. apply $+10^6$ V/CM (10^6V/CM = 10V for 1000A) with respect to substrate for 5 + 1 minute; cool wafer with bias applied. Use 20 volts bias minimum for 10,000Å.

d. Rerun CV plot.

6. Furnace Profiles: In order to minimize thermal gradients, temperature ramping of the furnaces is recommended. Automatic slow pullers can also help minimize the effect of temperature gradients during insertion and withdrawals of the wafers.

7. Epitaxy Stacking Faults: Stacking fault measurements should be made within a circle excluding the outer 0.25" of the wafer. Sampling method shall be at least the four quadrants and center, covering a minimum of 5 fields of view.

APPENDIX B

List of Attendees

CLASS S MICROCIRCUIT INTERCHANGE MEETING

December 15, 1978

ATTENDEES

Advanced Micro Devices
901 Thompson Place
Sunnyvale, Ca 94086
Kirk Lindsay
Richard D. Munday
Len Seib
Steve Thompson

Fairchild Semiconductor
464 Ellis Street
Mountain View, Ca 94040
J. R. Bryne

Harris Semiconductors
P. O. Box 883
Melbourne, Florida 32901
J. L. Davidson
E. R. Freeman
Hi-Rel Project Mgr

Harris Semiconductors
2016 Quail Street
Newport Beach, Ca 92660
L. Weiss

Integrated Circuits Eng'r Corp
6710 E Camelback Road
Suite 211
Scottsdale, Arizona 85251
Glen Madland

Integrated Circuits Eng'r Corp
100 N Winchester Blvd
Suite 260
Santa Clara, Ca 95050
John D. Shea

Intel Corp
3065 Bowers Ave
Santa Clara, Ca 95051
Rocky Evans
Military/Program Mgr
Anthony Cara
Military QA Mgr

Intersil Inc
10900 N Tantau Ave
Cupertino, Ca 95014
Ed Mello
Quality Services Mgr

Motorola Semiconductor
Integrated Circuits Division
P. O. Box 20906
Phoenix, Arizona 86036
L. D. Hirsch

National Semiconductor Corp
2900 Semiconductor Drive
Santa Clara, Ca 95051
R. C. Berryman
Program Mgr
Tom Bispo
George Fulhorst
Jim P. Martin
Mil/Aero Marketing Mgr
Gus Pfaehler
Dir, Military/Aerospace Marketing
Jerry Streb
Military/Aerospace Marketing
Fran Warner

Plessey Semiconductors
1641 Kaiser Ave
Irvine, Ca 92714
Joseph Kapp

Precision Monolithic Inc
1500 Space Park Drive
Santa Clara, Ca 95050
R. C. Reinecke

RCA Corp
Solid State Division
Route 202
Sommerville, New Jersey 08876
Jack Handen
Mgr, Marketing
E. M. Reiss
Mgr, MOS Hi-Rel Eng'r

RCA Corp
Solid State Division
6363 W Sunset Blvd
Hollywood, Ca
David M. Griswold
Mgr, Gov't Marketing Dev

Signetics Corp
811 E Arques Ave
Sunnyvale, Ca 94086
Bob Beckwith
Dick Lambert
Chuck Leong
Ed Macaruso

Siliconix Inc
2201 Laurelwood Road
Santa Clara, Ca 95054
Richard L. Goldman
Program Mgr

Texas Instruments Inc
P. O. Box 5012
Dallas, Texas 75222
K. Benson
QRA Mgr
H. B. Shankle

Defense Electronics Supply Center
Dayton, Ohio 45444
R. Grillmeier
Richard Thomas
Col. Loren A. Anderson

NASA Hq
400 Maryland Ave SW
Washington D.C. 20546
J. L. Murphy (Code Z)

NASA
Marshall Space Flight Center
Huntsville, Ala 25812
Leon C. Hamiter, Jr.
Chief, Parts & Microelectronics

Naval Weapons Support Center
Crane, Indiana 47522
Marvin M. Hicks

SAMSO/AW
World Way Postal Center
P. O. Box 92960
Los Angeles, Ca 90009
Lt Col K. L. Blakney
Col N. J. Johnson
Col W. L. Schlosser
E. G. Lindsey

SAFSP-7
World Way Postal Center
P. O. Box 92960
Los Angeles, Ca 90009
Capt Terry Lamb

The Aerospace Corporation
P. O. Box 92957
Los Angeles, Ca 90009
W. J. Aston
A. J. Borofsky
A. J. Carlan
J. J. Egan
W. F. Leverton
M. T. Weiss
J. F. Wiesner
M. M. Metfessel

APPENDIX C

Porter Dunlap (NASA/MSFC) Letter to
Rome Air Development Center
(Attn: Mr. Joe Brauer, RBRM)
Subject: Changes to MIL-M-38510 and MIL-STD-883
(3 February 1978)

National Aeronautics and
Space Administration

George C. Marshall Space Flight Center
Marshal. Space Flight Center, Alabama
35812

NASA

Reply to Attn of:

EG02

February 3, 1978

Mr. Joe Brauer, RBRM
Rome Air Development Center
Rome, NY 13441

Dear Mr. Brauer:

Enclosed are some changes that have been developed by SAMSO and NASA to MIL-M-38510 and MIL-STD-883. You are requested to make these changes when the next amendments are issued. If further technical information is needed, please contact Leon Hamiter, EC43, telephone (205) 453-4562.

Sincerely,

Porter Dunlap
Manager, NASA Standard
Parts Lead Center Office

Enclosure

cc:
SAMSO/Mr. Lindsey
DESC/Mr. Gonzalez

1. ACTION: Recommend the following replace paragraph 3.4.1.2.4 of MIL-M-38510D:

"When other than Class S product is being manufactured on a certified line, controls shall be maintained such that adverse impact does not occur to Class S products. The specific difference in controls for non Class S product shall be identified in the baseline manufacturing flow chart (Ref: Appendix A, paragraph 20.1.3.2).

2. ACTION: a. Recommend the following paragraph be added to MIL-M-38510D:

"4.6.5 Nondestructive Bond Pull for Class S Devices. When a 100% nondestructive bond pull test is specified for Class S devices, it shall have a percent defective allowable (PDA) of two percent (2%) or less based on the total number of leads pulled in a specific lot. Parts subjected to 100% nondestructive bond pull test shall not be delivered as Class S product unless specified in the ordering data of the purchase order."

b. Recommend that the attached nondestructive bond pull test procedure be added to MIL-STD-883B, Method XXXX.

c. Recommend adding the requirement for nondestructive bond pull test to MIL-M-38510D, paragraph 3.4 prior to "Internal Visual (Precap)," and reletter "a". Reletter the remaining requirements accordingly. Under columns labeled "Class S" designate the nondestructive bond pull test as "Optional" when specified per the ordering requirement of paragraph 6."

3. ACTION: Recommend change to MIL-M-38510D, paragraph 4.1.1.1:

a. Change "Cases and Cases" to "Case and Case"

b. Change 4.1.1.1 to read:

"4.1.1.1 Metal flat package isolation test for Class S Devices: Prior to die mount each metal flat package shall.... Metal flat packages which exhibit...."

4. ACTION: Recommend that MIL-M-38510D, paragraph 5.1 (b) be changed to read:

"(1×10^{12} Ω - cm maximum)"

MIL-STD-883B

5. ACTION: Paragraph 3.4.6.1, Delete the last sentence.

6. ACTION: Method 5005.4, paragraph 3.8.2, MIL-STD-883B needs correction.

Recommend the following change to MIL-STD-883B, paragraph 3.8.2:

Change "subgroup 2" on the second line to "subgroup 1."

7. ACTION: Recommend the following change to MIL-STD-883B:

Method 20103, "Remove note after 3.1.5.1a."

8. ACTION: Method 5005.4, Recommend adding the following sentence to the end of section 3.2 :

"When an inspection lot is composed of two wafer lots, each wafer lot shall be proportionately represented in the quality conformance test samples. A minimum of one device from each wafer lot shall be included in the sample for subgroups 2(b), (c), and (d) and 5."

PROPOSED METHOD XXXX
NONDESTRUCTIVE PULL TESTING OF WIRE BONDS

1. Purpose: The purpose of this test is to destroy non-acceptable wire bonds while avoiding damage to acceptable wire bonds. This procedure is useable for bonds made by either ultrasonic or thermal compression techniques involving wire sizes fro . 0.0007 to 0.003 mils.

2. APPARATUS

The apparatus for this test shall consist of suitable equipment for applying the specified stress to the bond, lead wire or terminal as required in the specified test condition. A calibrated measurement and indication of the applied stress in grams force (gf) at the point of failure shall be provided by equipment capable of measuring stresses up to and including 10 gf with an accuracy of ±0.2 gf, and stresses between 10 and 50 gf with an accuracy of ±0.5 gf.
50 gf with an accuracy of ±2.5 percent of indicated value.

a) The radius of the "J" hook used to apply force to the interconnect wire shall be 2 to 3 x the wire diameter.

b) The "J" hook shall be smooth and free of defects which could compromise the test results.

c) There shall be no "impact" loading of the wire.

d) All testing shall be accomplished under observation at 20x minimum magnification.

e) The fixturing which holds the package and/or the force application fixture shall allow rotation and tilting to meet the requirements of Figure 1.

f) The dynamometer shall measure the explicit force required to cause failure of the interconnect.

g) The "J" hook shall not be in a fixed position which restricts motion along a straight line between each bond, i.e., as the load is applied the hook shall be free to center itself.

3. Test Conditions

3.1 Calibration:

a. Assemble the wire-bond pulling machine as it will be used to perform the wire-bond pull test. Use the same pulling hook as will be used in the test.

b. Attach calibration weights of appropriate mass to the pulling hook.

c. Observe and record the measured force.

d. Plot the measured force values as a function of the forces applied by the weights. Draw a calibration curve through these points.

3.2 PROCEDURE

The test shall be conducted using the test condition specified in the applicable procurement document consistent with the particular device construction. All bond pulls shall be counted and the specified sampling, acceptance and added sample provisions shall be observed, as applicable. Where there is any adhesive, encapsulant or other material under, on or surrounding the die such as to increase the apparent bond strength, the bond strength test shall be performed prior to application of such material or after total removal, as would be required in screening.

a. Mount the specimen to be tested and set the lifting mechanism to apply the maximum force for the appropriate wire size and material.

b. Carefully place the hook under the center of the wire-bond loop.

c. Set the rate of force application.

d. Actuate the lifting mechanism to stress the wire bond.

e. Observe whether the bond breaks.

f. If the bond breaks, record the identification of the bond and the device containing the bond.

g. If the bond does not break, accept it as satisfactory.

h. Repeat a through e for all bonds to be tested.

i. Record the total number of wire bonds that fail when subjected to the predetermined stress.

j. Record the number of devices that failed the test.

TABLE I

PULL FORCE FOR NON-DESTRUCTIVE
BOND PULL TEST

WIRE DIAMETER	PRE SEAL		POST SEAL AND OTHER PROCESSING AND/OR SCREENING	
	ALUM	GOLD	ALUM	GOLD
0.7 mil	1 g	1 g	1 g	1.5 g
1 mil	2 g	2 g	1 g	2 g
2 mil	6 g	6 g	2 g	3 g
>2 mil	--	--	3 g	--

3.3 Records:

a. The report shall include the following:

b. Name of the person performing the test,

c. Date of the test.

d. Identification of the microelectronic specimen.

e. Identification of the specific wire bond tested,

f. Identification of wire by spool and lot,

g. Identification of bonding machine,

h. Mean and standard deviation of the destructive wire-bond pull test, as well as the total number of wire bonds so tested,

i. Percentage of wire bonds that failed upon application of the predetermined safe maximum NDP force.

4. Summary: The following details shall be specified in the applicable procurement document.

a. Calibration procedure if other than specified in 3.1.

b. Safe NDP force if other than specified in Table 1.

$\theta = 90^{\circ} \pm 5^{\circ}$ to straight line drawn between bonds; straight line shall pass through back extruded region of ball bond and/or the interface of wedge bonds.

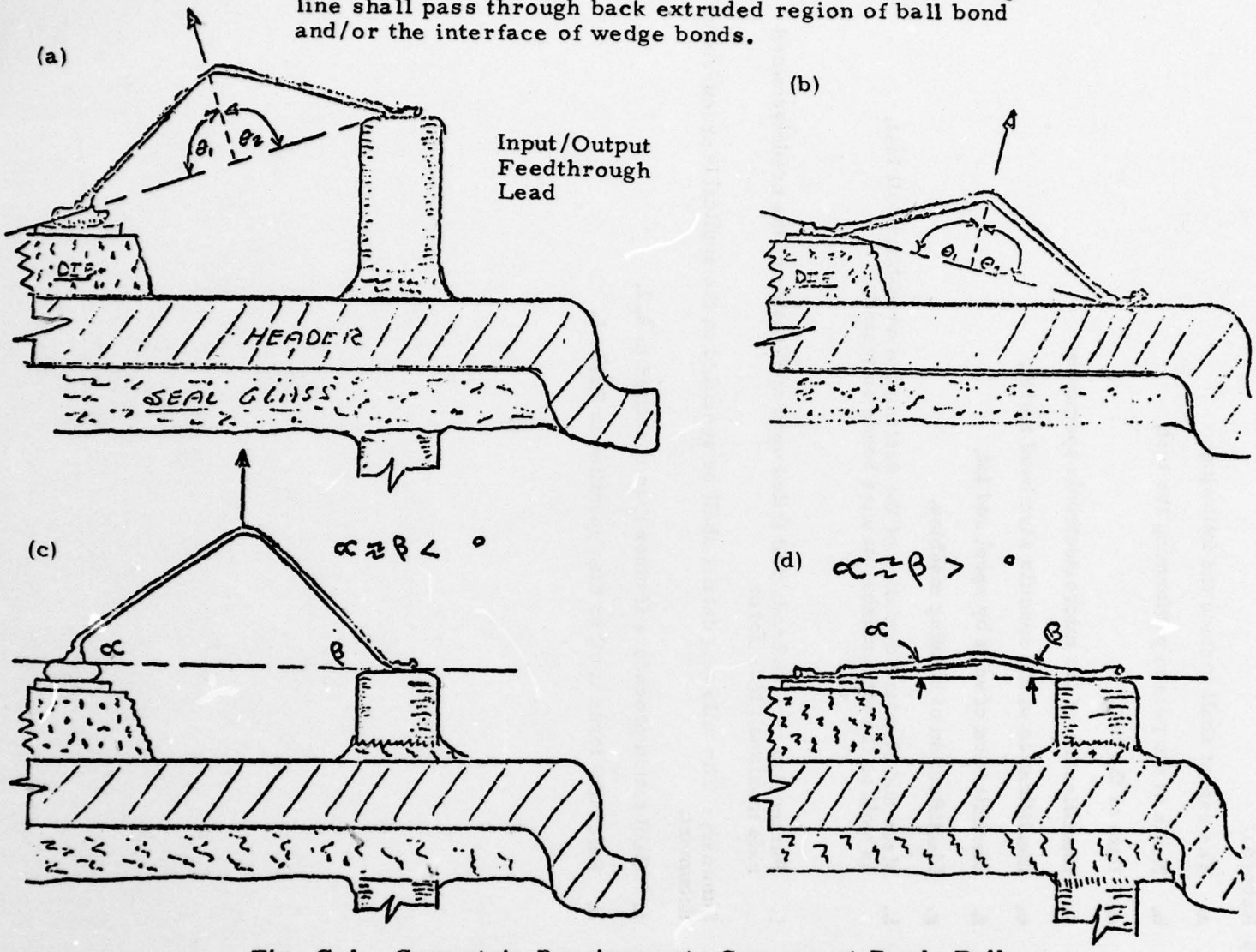

Fig. C-1. Geometric Requirements Concurrent Bonds Pull